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The Journal of the Department of Agriculture

VICTORIA — AUSTRALIA

VOLUME XXXIII

PART 2

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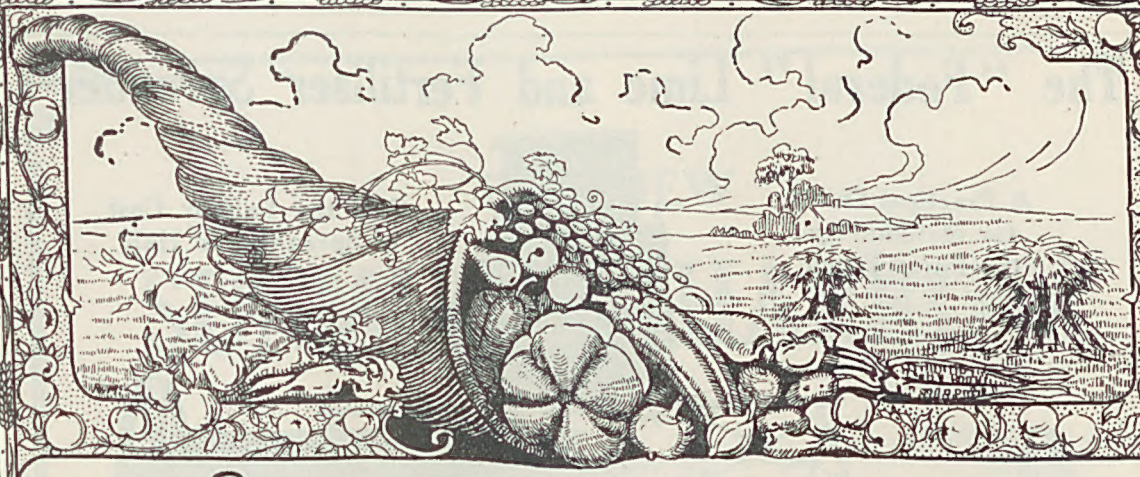

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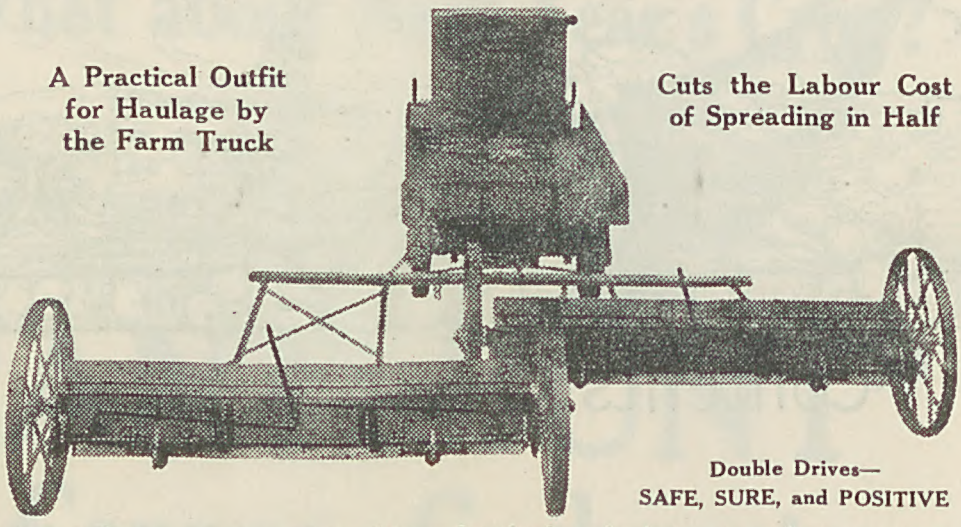

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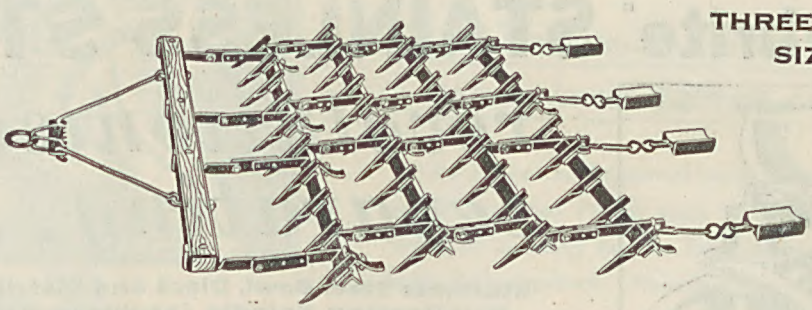

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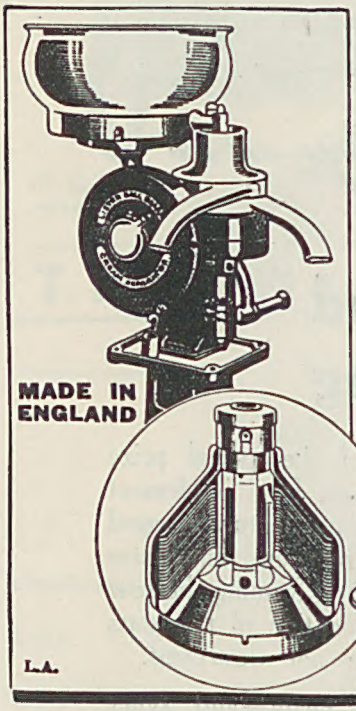

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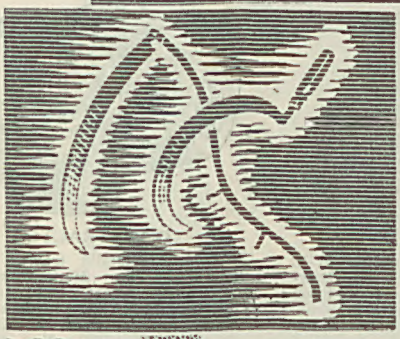

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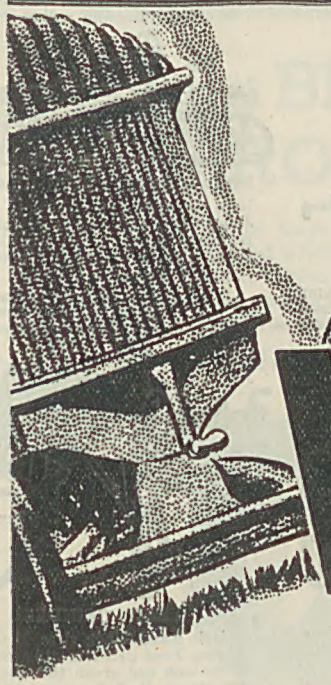

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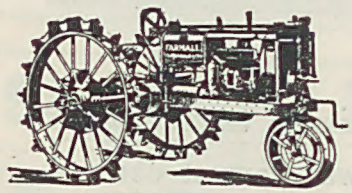

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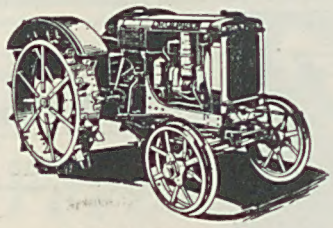

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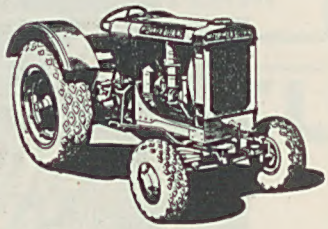

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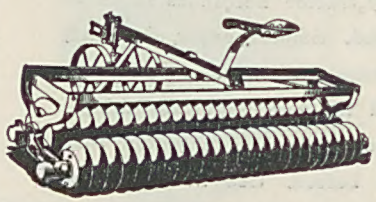

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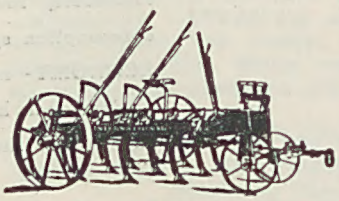

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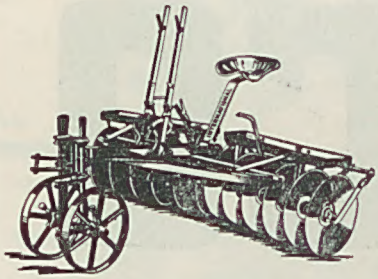

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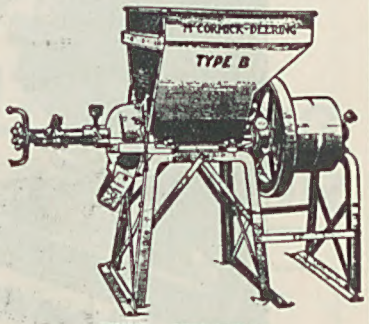

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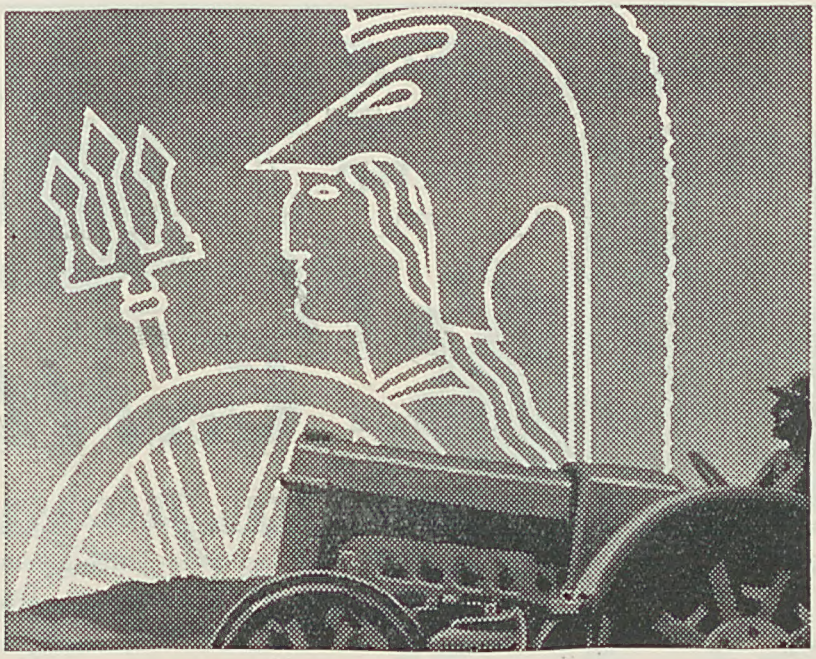

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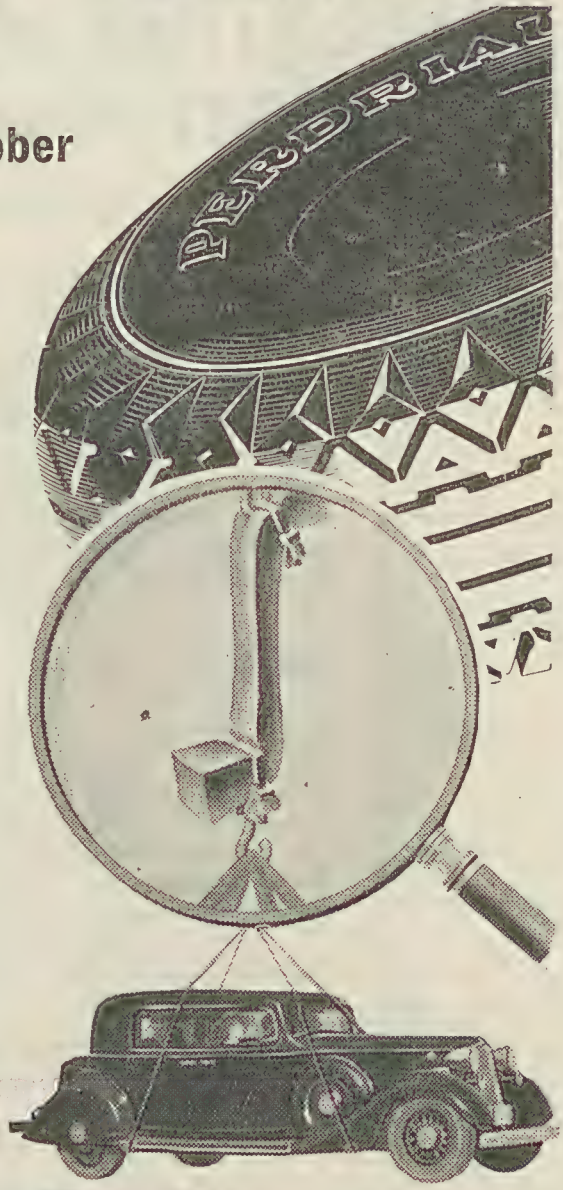

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The Journal of the DEPARTMENT of AGRICULTURE of VICTORIA

Seasonal Growth of Victorian Pastures

The Influence of Artificial Fertilizers

By R. L. Twentyman, B.Agr.Sc., Agrostologist

Paper read before the Congress of the Australian and New Zealand Association for the Advancement of Science, Section K (Agriculture and Forestry), Melbourne, January 1935.

DURING recent years, the growth of pastures has attracted a great deal of interest, and more recently attention has been given to the season of growth as well as to the total bulk of growth produced during the year. While most pastures consist of a very heterogeneous collection of plants, it is found usually that the net result of the combined growth of these plants is to produce an abundance of growth at one season of the year, while at other times they are almost dormant. This irregular growth occurs throughout most of the pasture lands of the world, and is, in the main, a response to the local climatic conditions prevailing.

Victorian pastures, like those of other countries, vary greatly in growth from season to season of the year, and the several pasture types vary considerably among themselves and show characteristic peculiarities. These local fluctuations largely determine the particular type of animal husbandry practised, and here in Victoria we find different methods of grazing being resorted to in order to consume economically the growth on the pastures. In the north, for instance, fat lamb raising is resorted to in order to consume surplus spring growth. In parts of the Western District, where the summer rainfall is light, the grass is left standing in the paddocks to be consumed in the following autumn and winter while, on the best pastures, excess growth is cut and stored and dairying practised.

In the northern parts of the State where the rainfall is light, the natural pastures consist mainly of Danthonia, together with other grasses which mature early in the spring and make little or no growth during the following summer and autumn. Depending on the rains, some green growth usually is produced late in the autumn, but vigorous growth generally is restricted to the spring period when, during a growing period of about three months, approximately 70 per cent. of the growth for the year is made. Similar growth occurs on the native pastures in the southern parts of the State, but here, late autumn and winter growth is checked by the cold and wet condition of the soil during that time.

While the climate has a most important influence on the rate of growth of a pasture, soil fertility and the types of grasses and clovers present have an important bearing on the general productivity of the pasture. This is exemplified in the numerous instances of improved and unimproved pasture to be found throughout the State, where merely a fence

line separates two pastures which, though subjected to the same climatic conditions, yet show vastly different times and rates of growth. In the one case, the pasture may be barely able to maintain a sheep to the acre, whilst the adjoining land is improved to such an extent that dairying is practised.

But even with these improved pastures the rate of growth during the season fluctuates enormously and, although for a few months during the spring the pasture growth may be capable of maintaining two cows per acre, yet during the long summer and winter periods growth may be almost at a standstill.

Until recently, this uneven seasonal growth was regarded merely as an interesting fact and dismissed as such, but with the advent of intensive rotational grazing and the nitrogenous fertilization of pasture land, a great deal of attention has been given to the bridging of the lean winter period and the better utilization of the surplus spring feed.

For the successful practice of intensive rotational grazing, it is desirable that there shall be a reasonably long period of good uniform pasture growth throughout the year. Under irrigation conditions, where for a large portion of the year the rate of growth can be controlled, the scheme is quite practicable, but under the usual conditions prevailing in the dairying distiicts of Southern Victoria, the scheme can be successfully applied for only a short period of the year, and for the remainder there is alternately a surplus and scarcity of feed. For dairying it is essential to have a continuity of feed throughout the whole year, and where this is not supplied by the pasture growth. the pastures will have to be supplemented by conserved fodder.

The early experimental pasture work conducted by the Department of Agriculture was confined mainly to measuring pasture growth by means of weighed cuttings taken from the pastures in the late spring when the growth had reached the hay stage. Work which was commenced by the Department at Darnum in 1929. and which was later extended to Warragul and Colac, aimed at studying the response of pastures to dressings of nitrogenous fertilizers applied at regular intervals throughout the year. As these plots were cut at regular intervals by means of a lawn mower, it was possible to obtain a record of the rate of growth throughout the year.

Later, experimental work which was undertaken by the department in co-operation with the Victorian Pasture Improvement League provided the opportunity for studying the nature of the variations in rate of growth over a wide range of pastures throughout the dairying districts of southern Victoria. This work includes manurial trials laid down on existing grass land typical of the good pastures of the various districts. The experimental areas are divided into a number of narrow strips to which the various manures are applied at the specific rates—the bulk of the fertilizer being applied in the autumn. Following on this treatment, the growth on the pasture is cut and weighed by means of a motor mower whenever it reaches a stage which would justify grazing. According to the time of the year and the rate of growth, so the periods between the actual defoliations vary.

The results obtained from these plots have shown extraordinarily large variations in growth from season to season but, despite the fact that the pastures vary greatly in their botanical composition and the soil types are very dissimilar, there is a considerable uniformity in their seasonal responses.

Of all the Victorian pastures that have been examined, that of Darnum is outstanding in its ability to provide a continuity of pasture growth throughout the year. Some of the other pasture types appear to be capable of making almost as good growth during the late spring, but they compare very unfavorably with Darnum during the autumn, winter, and early spring periods.

The outstanding characteristic of the Victorian pastures is their almost complete cessation of growth early in the summer period, from which condition they may or may not recover before the following spring. It is their behaviour during this period that distinguishes the good from the indifferent pastures. Expressed as a total yield of produce for the whole year, some of the pastures appear to be quite satisfactory, but a study of the monthly production shows long periods of negligible growth during which time it would be necessary to supplement the feed obtained from the pasture. The better pastures show a fair recovery of growth in the autumn, and although growth is checked by the cold winter weather, there is a rapid resumption of growth early in the spring.

It seems that in attempting to improve pasture growth, we should aim at improving the growth during this lean period. In the

past, many attempts at pasture improvement had as their basis the introduction of summer-growing species into the pasture, but the complete cessation of growth on all our pastures during the normal summer would suggest that there is little hope for improvement by this means. With an unusually mild summer, such as we are experiencing this year, summer-growing species would be encouraged but in a normal summer our pasture soils are so completely dry as to check all growth.

A comparison of the monthly growth on the good and poor pastures reveals that the greatest difference is shown during the late autumn and early spring periods. It will be seen from Fig. 1 that the growth of the Gippsland flats, which are noted for their excellence as dairy pastures, is maintained at a reasonably high level throughout the winter, whereas growth on the plots in the red hill country during this period is almost at a standstill.

In the Western District (Fig. 2), growth in the late spring is checked by the dry hot weather conditions, and following on the extremely desiccating period to which the soil is subjected, good soaking autumn rains are required before the pasture recommences growth after the

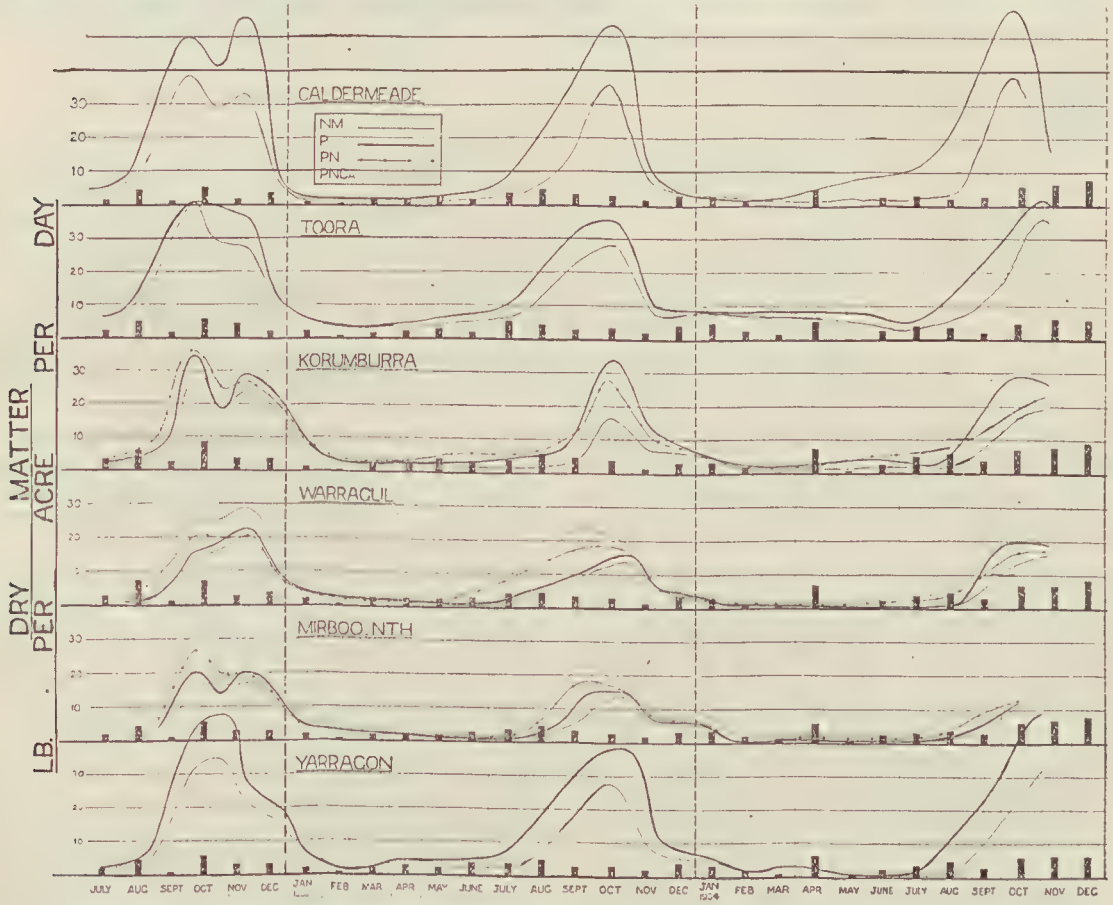


Fig. 1.—Showing seasonal growth of Gippsland pastures, and the effect of various manurial treatments during the period July, 1932, to October, 1934.

A complete range of manures was tried at all centres, but only those treatments which gave outstanding differences are shown. The manurial dressings, indicated in the legend, are as follow:—NM = No manure, P = Superphosphate 2 cwt. p.a., PK = Superphosphate 2 cwt. + muriate of potash 1 cwt. p.a., PN = Super. 2 cwt. + Sulphate of ammonia 2 cwt. p.a. (1 cwt. in autumn, 1 cwt. in spring), PNCa = Super. 2 cwt. + Sulphate of ammonia 2 cwt. (1 cwt. autumn, 1 cwt. spring) + Lime 1 ton p.a. (1932 only).

The small black vertical columns along the baselines indicate the monthly rainfall in inches.

Note the poor growth of the cocksfoot pastures on the red hill country of Gippsland (Warragul and Mirboo North).

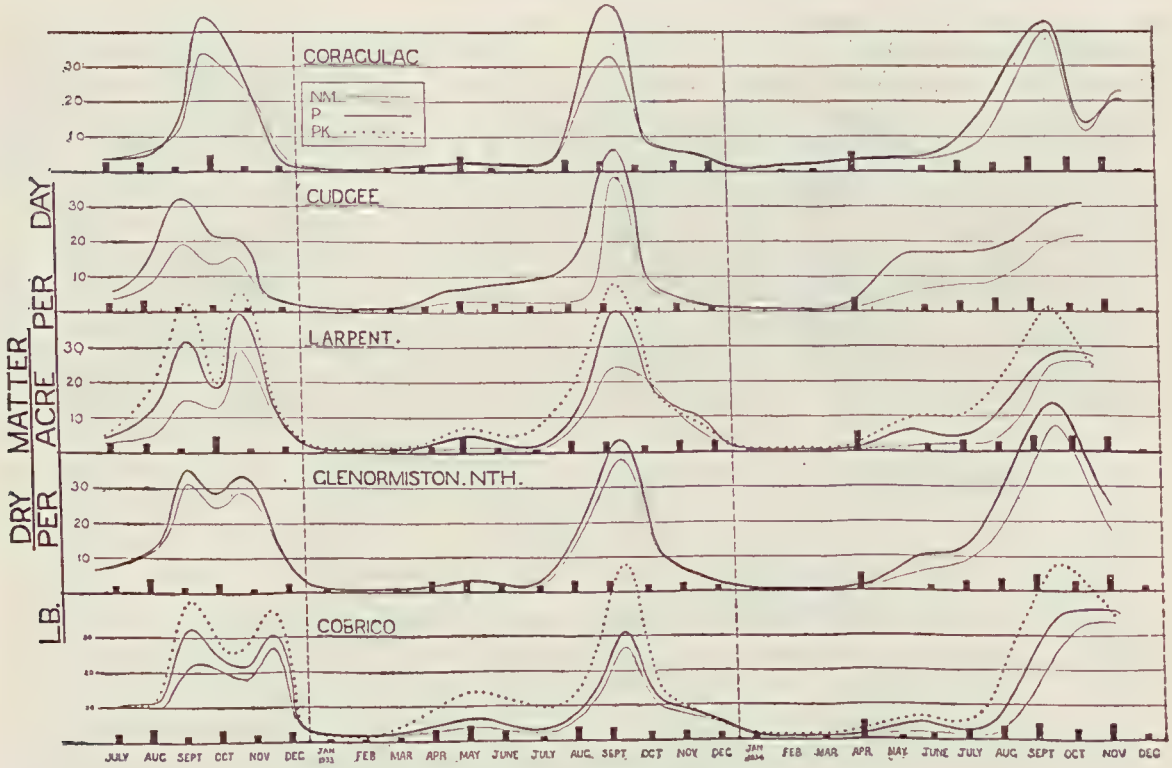

CORACULAC
NM.
P
PK
CUDGEE
LARPENT.
GLENORMISTON. NTH.
COBRICO
DRY MATTER PER ACRE PER DAY
LB.
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC

Fig. 2.—Seasonal growth of Western District pastures.

For period of growth, manurial treatment, rainfall, &c., see explanation to Fig. 1.

summer. With normal rains on the loose volcanic soils, the annual grasses and trefoils make vigorous late autumn and winter growth, but, with the perennial pastures on heavy soils, good early autumn rains are required if the pastures are to make any material growth before the winter. It is in this respect that the use of superphosphate has proved of such great value on the light soils of the Western District. These soils, which are readily saturated by light autumn rains, are generally too poor to encourage satisfactory pasture growth, but, stimulated by the application of superphosphate, they give very much better autumn growth than might be expected from their composition.

It is the condition of soil moisture during the autumn months that very largely determines the value of a pasture in providing a continuous supply of greed feed. Following on the usual long dry summer period, the soil is completely dried out to a considerable depth in the early autumn. The heavy clay soils which frequently dry out and crack deeply require very much heavier rains to promote autumn growth than do the shallow sands or silt loams. This effect is very marked in the Balmoral-Edenhope district of Western Victoria, where there is a large tract of country in which subterranean clover has been introduced with the aid of top-dressing. The rainfall of the district is uniform over the area, but it is only on the lighter soils that the subterranean clover regularly makes good autumn and winter growth. On the heavier soils, the re-establishment of the subterranean clover during the autumn is uncertain, and although it usually makes good growth in the spring, it is only following good soaking autumn rains that it does really well in the early part of the year.

Production curves which have been obtained for Victorian pastures show that the bulk of the growth is made in the spring. Ideal growing conditions exist for a short time in the early spring, but then the rapid growth of grass soon gets out of hand; the growth becomes stemmy and unpalatable, the quality falls off, and the cows rapidly decline in milk. This prolific growth of grass makes a heavy drain on the moisture supply of the soil, which quickly dries out and growth ceases.

Fig. 3.—Strong growth of perennial rye-grass and subterranean clover at Larpent. Weighed mowing strips have been cut from the plots, prior to the cutting of the border strips (unweighed).

If this large flush of growth in mid-spring could be checked, a much more uniform season of production could be maintained. The cutting of the pasture in mid-spring for silage provides an effective check to growth, but this method has not been adopted here, and what little grass silage is made is cut very little in advance of the grass hay stage, by which time the pasture usually has matured sufficiently to have advanced beyond the stage at which a satisfactory aftermath growth can be expected.

The production curves shown have been obtained under a method of regular defoliation which approximates to the treatment a pasture would receive under the intensive rotational grazing system, and for this reason they probably show the seasonal growth to better advantage than would occur under normal grazing conditions where paddocks usually are grossly over-stocked during the winter, and under-stocked in the spring.

Having determined the nature of the growth produced on the better types of Victorian dairy pastures, it is desirable to ascertain in what manner and to what extent this can be influenced by applications of artificial fertilizer. Here it should be understood that the artificial fertilizer usually has a direct and an indirect effect on the pasture. The direct effect is shown in the initial stimulus given to growth as a direct result of the dressing of fertilizer, whereas the indirect effect is brought about through the increased growth and increased accumulation of animal droppings which, together with the usual increase in the clover content of the pasture, result in an increase in the natural nitrogen supply of the soil.

From a study of the effect of applications of nitrogen made to Victorian pastures, it is obvious that the nitrogen deficiency is largely the cause of the poor winter growth made by our weaker pastures. Where soil moisture is not the limiting factor, a dressing of a nitrogenous manure usually gives a rapid stimulus to pasture growth, and the large difference in growth shown between the good and poor winter pastures appears to be mainly due to the ability of certain soils to provide an abundant natural supply of nitrogen. Ultimately, the indirect effect of the fertilizer extends to encouraging the growth of the more vigorous species under the improved fertility conditions, and the pasture may be vastly altered in comparison with its original composition.

The results shown on the accompanying graphs have been obtained under conditions which would enable the direct responses to the manures to be measured, but as it has not been practicable to make any return of "fertility" to the plots in the form of animal droppings to compensate for the vegetation removed, there has been no opportunity to make any measure of the improvement which would be brought about as a result of the accumulation of fertility. On weak pastures this cumulative fertility is of considerable importance, but on most of our dairy pastures which have already been built up to a fairly high standard of fertility it does not appear to have any great bearing on the results of the experiments.

A very laborious technique would have to be developed before these secondary effects could be measured on country plots, and at present it would seem that as long as we can obtain a measure of the initial response to the fertilizer, then the probable main secondary effects can be deduced. In these experiments conducted under the Pasture Improvement League scheme, there have been included, as a check on the quantitative manurial trials, larger areas which are similarly fertilized, but which have been fed off by means of grazing stock. These plots received a continuous return of manure in proportion to the time which the stock spend grazing on them, and in this respect should show to advantage in comparison with the mowing trial area. Usually this has not proved to be so, and in most cases there has been no appreciable

difference between the vigor of growth on the grazed and the mowing areas, despite the fact that all the produce grown on the mowing section has been constantly removed and no compensating return of plant food has been made.

Ever since the lawn mower method of measuring the growth of grass was commenced it has been subjected to the criticism that it was not the natural means of defoliation, and as there was no return of "dung" and urine, the fertility of the paddock would be rapidly depleted. Obviously, any method which continually removes plant food from the soil without making any compensating return of organic material will eventually deplete the soil fertility, but this process is by no means as rapid as many have claimed it to be. There is no doubt that where a pasture is kept short by means of repeated mowings at frequent intervals, there is a marked tendency for the low growing species and the rosette type of weeds to increase, but where the intervals between mowings are larger, this tendency is not so pronounced, and on most of our plots it has not become of major importance. The continuous mowing and the removal of produce from the plots at Colac and Warragul over the past four and a half years have not yet materially weakened the growth on these areas, nor has the composition of the sward been greatly altered as compared with the surrounding paddocks which have been subjected to grazing.

Fig. 4.—Showing the abundant spring growth of perennial rye grass on mowing plot at Coragulac. Strips cut by the special grass cutter are not shown clearly owing to the height of the uncut border strips.

This might appear contrary to the usual experience under normal farming conditions, where the repeated cutting of a paddock for grass hay soon lowers the productivity of the field, and such fields later make very poor autumn and winter growth. Under these conditions it would appear that it is those elements of the pasture which make vigorous growth in the late spring that become very strongly developed to the exclusion of the winter-growing forms. Pasture plants, like most other plants, appear to have a definite season of growth. By competition and natural selection, this period has been made to coincide with the season of favorable spring growth, and these two forces acting together result in the annual spring flush of growth. It might be thought that so long as favorable conditions persist through the spring, there will be a prolific growth of the pastures, but there seems to be an annual period of maximum growth, and although subsequent favorable weather conditions may prolong the season of growth, once this peak period is passed the growth of the pasture rapidly declines. In a mixed pasture it is quite possible that later maturing species may take advantage of the favorable conditions, but in most cases such species are not sufficiently numerous to give rise to another flush of growth.

In this regard it has been repeatedly noticed on some of the small pilot plots, on each of which half the area was ploughed and sown down while the other half was merely top-dressed with super., that although the area sown down with what are regarded as the superior grasses and clovers might make better winter growth, yet during the spring months the top-dressed existing pasture makes very much stronger growth. It would seem that these volunteer species have become established on account of their ability to make prolific growth during the favorable spring period, and the other species are crowded out. If the pasture was to be valued solely for its ability to produce a large annual bulk of feed, then these volunteer pastures

TABLE 1.—CHEMICAL ANALYSIS OF SOILS FROM GIPPSLAND AND WESTERN DISTRICT PASTURE EXPERIMENTAL PLOTS.

Samples taken from 0 to 4" from unmanured strips. Results shown in parts per 100,000 on air dry basis.

GIPPSLAND

Locality	N	P_2O_5	K_2O	CaO	MgO	Cl	pH
Toora	168	68	154	200	176	10	6.6
Mirboo North	174	77	104	180	196	12	5.5
Caldermeade	364	61	118	242	306	2	5.6
Korumburra	206	54	99	234	243	2	5.9
Warragul	285	126	63	184	229	2	5.5
Yarragon	156	51	67	124	293	4	5.9
Poyser	188	51	96	200	80	32	4.9
Leongatha	263	94	144	440	600	10	7.8
Gallipoli	152	170	175	254	437	2	5.8
Boolarra North	235	60	210	444	404	4	6.2
Longwarry	207	41	28	134	125	4	5.0
Moe	123	19	41	80	113	4	5.2
Morwell	162	25	12	106	91	4	5.3
Nar Nar Goon	162	41	51	186	145	4	5.6
Berrecan	352	74	124	260	459	4	5.7
Koorin South	274	103	128	802	442	4	6.2
Mirboo	218	72	189	224	231	4	5.8
Pakenham	145	42	53	134	149	10	5.6
Rokeby	274	41	230	438	357	4	6.1
Strzelecki	274	78	161	336	302	4	6.3
Thorpdale	336	64	209	394	493	10	6.5
Traralgon	156	64	47	148	175	26	5.3
Welshpool	207	45	122	170	181	4	6.0
Yinnar	280	61	121	190	198	8	5.8
Dermun	202	110	403	216	171	14	5.6

WESTERN DISTRICT

Locality	N	P_2O_5	K_2O	CaO	MgO	Cl	pH
Cudgee	144	42	43	90	33	8	6.2
Glenormiston Nth.	464	163	178	170	250	18	5.8
Coragulac	325	403	386	690	1954	8	6.4
Larpent	302	64	96	130	145	10	6.0
Coorica	200	32	96	160	116	10	5.5
Birregurra	375	93	236	250	242	12	5.8
Bochara	134	67	120	70	90	6	6.3
Buckley	156	61	130	110	69	8	6.2
Casterton	224	125	439	230	272	12	5.7
Coleraine	140	26	106	80	80	10	6.0
Deans Marsh	218	54	121	130	134	10	5.7
Koklin South	263	48	82	70	98	10	5.7
Gerrogo	258	67	110	170	98	10	5.9
Macarthur	212	74	96	200	98	10	5.7
Mering	319	141	362	400	118	10	5.5
Martlake	195	38	96	170	72	12	5.8
Neerat	442	224	270	890	5752	14	6.2
Penshurst	291	64	196	270	344	12	5.9
Port Fairy	246	153	280	6840	340	6	7.9
Stonyford	750	320	232	450	492	12	6.2
Heywood	302	80	202	250	532	10	6.2
Timboon	145	26	38	70	98	10	5.2
Colac Home Field	232	64	112	160	124	10	5.5
Colac Railway Field	328	87	234	384	330	16	5.4

N = Nitrogen, supplied as sulphate of ammonia, P_2O_5 = Phosphoric acid supplied as superphosphate, K_2O = Potash supplied as muriate of potash, CaO = Lime applied usually as carbonate of lime, but also as slaked-lime and quicklime.

The narrow black columns in front of the individual figures represent the approximate responses to the corresponding fertilizers, the maximum being indicated by a full column and no response by a blank. At Heywood, a good response to lime was obtained in the first two years, but there was no increase in the third year.

would appear more valuable than the sown pastures, but the value of their extra spring growth is frequently discounted by their weak growth for the remainder of the year.

In attempting to spread the seasonal growth as far as possible, it is desirable that a pasture should include a mixture of species. Where soil fertility has not been the limiting factor with the pasture types studied, it appears that it is those pastures possessing the fewest species that show the greatest fluctuation in seasonal growth. It is probable that favorable growing conditions in the soil over a long portion of the year result in the presence of a wide range of species, but where growth on a perennial pasture is confined to a limited period of the year, then selection becomes more evident, and usually one or two species dominate the pasture. Though a pasture sown to a mixture of species usually will tend to be dominated by one or two species, if other species are present, even in small amount, they may become quite prominent in abnormal seasons, and in this way by occasionally checking the dominant species will assist in controlling the spring flush of growth.

The manurial trials include phosphates, potash, nitrogen and lime, generally applied in various combinations. Although spectacular results usually are obtained by the use of nitrogen, the most valuable increases have been obtained from superphosphate. In most cases potash has not been of any benefit, but in a few cases very good responses have been obtained from its use, and these increases have been well sustained. Lime has been included in all the trials, but only in a few cases has any improvement been recorded on the plots receiving this material. (See Table 1.)

The pastures on the major plots from which the measured results have been obtained had, in the past, mostly been built up with superphosphate, and the unmanured plots still show improved growth from the earlier dressings. Many of the pilot plots, particularly those situated on unimproved pastures on light soils, have shown a very large improvement following on the use of superphosphate, but as these plots are purely observational in character, no actual measure of the resulting improvement is available.

It has been particularly noticeable that where good responses have been obtained from superphosphate, this improvement has been most marked during the late winter and early spring period. Although heavier dressings

TABLE 2.—COMPARATIVE MANURIAL RESPONSES FOR WHOLE YEAR AND FOR WINTER AND EARLY SPRING PERIODS ONLY.

Average yields per cut in cwt. of greenstuff per acre.

WESTERN DISTRICT — AVERAGE YIELD PER CUT

Treatment	COBRICO.		CORAGULAC.		CUDGEE.		CLENORMISTON.		LARPENT.	
	Throughout Year	Winter-Early Spring	Throughout Year	Winter-Early Spring	Throughout Year	Winter-Early Spring	Throughout Year	Winter-Early Spring	Throughout Year	Winter-Early Spring
NO MANURE	15¼	7¼	19	15	14½	15	23	18	13¼	5
SUPER 2 cwt.	21	15	23	22¼	27	39	29	27	24	17¼
SUPER 2 cwt + S. or A. 2 cwt.	22	19	24	19	24¼	31	27	23¼	25¼	23¼
S. + S. or A. + LIME 1 ton	22	20	23	18	23	31	29	26	26	22
S. + S. or A. + POTASH 1 cwt.	29	30	23¼	17	26¼	37	29	24	31	32
SUPER 3 cwt.	20	15¼	26	25	27	38	29	26¼	25	18

GIPPSLAND — AVERAGE YIELD PER CUT

Treatment	CALDERMEADE.		KORUMBURRA.		MT. MIRBOO.		TOORA.		WARRAGUL.		YARRACON.	
	Throughout Year	Winter-Early Spring	Throughout Year	Winter-Early Spring	Throughout Year	Winter-Early Spring	Throughout Year	Winter-Early Spring	Throughout Year	Winter-Early Spring	Throughout Year	Winter-Early Spring
NO MANURE	20¾	13¼	15	6¼	10¾	5	24¾	20	8¾	4¼	16¼	6¼
SUPER 2 cwt	38¾	47¼	23¼	19	12¼	8	33¾	35	9¾	5¼	26¼	20
SUPER 2 cwt + S. or A. 2 cwt.	37¾	46¼	23¼	20¼	14¾	12¼	33¾	36	11¾	10¼	25¾	21
S. + S. or A. + LIME 1 ton	38¼	51¾	28¼	27	17¼	16¼	34¼	37¼	15	13	28¾	25¼
S. + S. or A. + POTASH 1 cwt.	38	50¼	26	25	15¼	14	35¾	39¼	12¼	11¼	27	23¼
SUPER 3 cwt.	40¾	51	26	19¼	13¾	9	34¾	35¼	10¼	5¼	27¾	22¼

have not given any further increase in growth in early or mid spring, they have succeeded in prolonging growth in the late spring. During the flush of spring it is frequently observed that plots which earlier had been showing a marked benefit from the use of super. fail to maintain the increased rate of growth, and make little better growth than the unmanured plots. (See Table 2.)

Under meadow hay conditions this effect is not very obvious, as the heavier growth on the manured plots appears to maintain the early start received; but where the plots are repeatedly cut back, it is found later in the spring that the unmanured plots make almost as rapid recovery as do the manured.

Where potash has given increased growth, the increase usually has been sustained throughout the spring. Good responses to this fertilizer have been recorded at Larpent and Cobrico, and during the past spring good increases were observed on three of the pilot plots. These responses have occurred on soils which, on chemical analysis, appeared to have a satisfactory potash content.

Although on most of the experimental plots lime has failed to give any material increase, there have been a few instances where it has given a stimulus to growth. Used in conjunction with super. and sulphate of ammonia on cocksfoot pastures in the red Gippsland hill country, it has given, through the stimulation of the clover, a 10 to 15 per cent. increase in growth throughout the year. Improvement from its use has been recorded also at Korumburra, and at Timboon and Heywood, in the Western District, increases have been observed. Results on the plot at Heywood have been somewhat erratic in that, while very marked responses were recorded during 1932-33, a further dressing given in 1934 failed to show any improvement.

In considering the seasonal growth of pastures, nitrogenous manures demand special attention. Following the recent interest taken in the use of nitrogenous fertilizers on pasture land, sulphate of ammonia has been given a prominent place in these experimental plots. As well as being applied with superphosphate, it has been tried also with both super. and

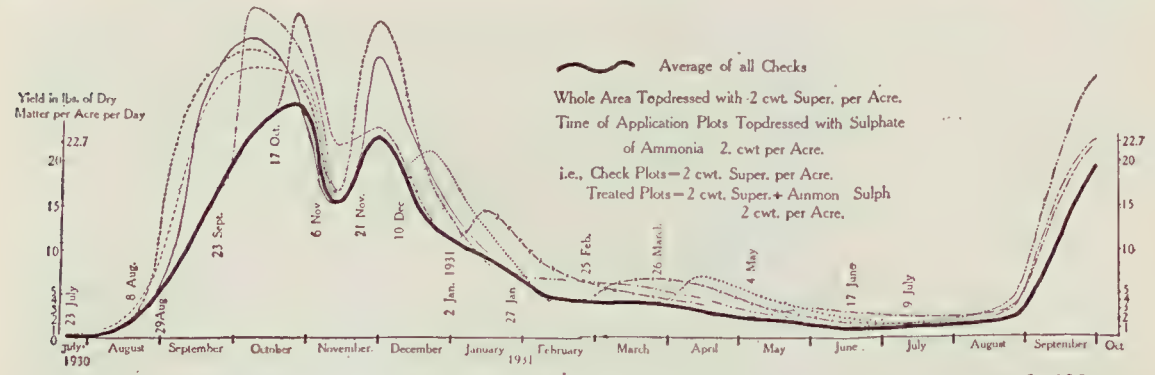


Fig. 5.—Production from the Time of Application of Sulphate of Ammonia Trials, Warragul, 1930-31.

The heavy line indicates the growth of greenstuff, in lb. per acre, per day, on the check plots receiving a basal dressing of superphosphate 2 cwt. per acre only. The lighter lines show the sharp increases in growth recorded as a result of the additional 2 cwt. of sulphate of ammonia per acre. The later depressed growth which usually follows the stimulus is not shown in this figure.

potash and super. and lime. Except on the red Gippsland hill country, neither lime nor potash appear to have had any modifying effect on the results or after-effect of the sulphate of ammonia, and the behaviour of these plots usually has been similar to those receiving super. and sulphate of ammonia only.

The dressings of sulphate of ammonia were applied at the rate of 1 cwt. per acre in mid-autumn and again in late winter or early spring. On account, probably, of unfavorable

TABLE 3.—TIME OF APPLICATION OF SULPHATE OF AMMONIA—WARRAGUL.

Sulphate of Ammonia 2 cwt. per acre.	Yields in lb. of Dry Matter per acre for the period between cuttings.											
Date Applied.	1st Cut.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.
July 23	+143	+130	+66	..	..	..	..	..	..	..	..	..	..
	..	..	..	−9	−49	−16	−20	−9	−19	−9	−24	−11	−33
August 8	+255	+164	+52	+15	+34	+48	+22	+32	+21	+3	+2	..	..
	..	..	..	..	..	..	..	..	..	..	..	−2	−28
August 29	+289	+188	+17	..	..	..	..	..	..	..	..	..	..
	..	..	..	−2	−66	−15	−35	−40	−19	−7	−16	−8	−32
September 23	+251	+141	+17	..	+16	..	+12	..	..	..	..	..	..
	..	..	..	−20	..	..	..	−10	−3	−13	−10	−12	−111
October 17	+220	+92	+15	+7	..	..	..	+8	+9	+11	+29	+62	..
	..	..	..	..	−30	−10	−11	..	..	..	..	..	−86
November 6	+20	+271	+111	..	..	..	..	+12	..	..	..	..	..
	..	..	..	−8	−31	−21	−11	..	..	−21	−121	−124	−53
November 21	+187	+142	+12	..	+2	+16	..	..	..	..	..	..	..
	..	..	..	−18	..	..	−7	−4	−34	−139	−160	−60	−23
December 10	+213	+77	..	+5	+2	+23	+5	..	..	..	..	..	..
	..	..	−12	..	..	..	..	..	−19	−56	−56	−13	−3
January 2	+130	+90	+32	+3	+13	+5	..	..	..	..	..	+2	+4
	..	..	..	..	..	..	−17	−82	−86	−43	−22	..	..
January 27	+46	+60	+61	+22	+15	..	..	..	..	+19	..	+2	..
	..	..	..	..	..	−12	−78	−72	−18	..	−1	..	−31
February 25	+64	+111	+41	+15	+23	+18	..	+1	..	+1	+22	..	..
	..	..	..	..	..	..	−37	..	−7	..	..	..	..
March 26	+153	+86	+25	+27	..	..	..	+7	+2	+34	+16	..	..
	..	..	..	..	−76	−107	−39	..	..	..	..	..	..
May 4	+75	+65	+63	+64	..	..	..	..	+19	..	..	..	..
	..	..	..	..	−80	−76	−22	..	..	−3	..	..	..
June 17	+21	+116	+248	+48	..	..	+1	+27	+9	..	..	..	..
	..	..	..	..	−16	−5	..	..	..	..	..	..	..
July 9	+11	+60	+76	..	..	+2	+4	+11	..	..	..	..	..
	..	..	..	−26	−52	..	..	..	−4	..	..	..	..
August 3	+82	+38	..	..	..	+4	+6	+17	..	..	..	..	..
	..	..	−30	−75	−2	..	..	..	..	..	..	..	..

The above table shows increases or decreases from plots receiving superphosphates and sulphate of ammonia, as compared with plots receiving superphosphate only, for period 1930–31. It will be seen that though there generally is an increase in growth measured in the first three or four cuts, this usually is followed by a prolonged period of depressed production.

weather conditions, the autumn dressings usually have given only a poor response. During the first two seasons, the spring dressing resulted in a rapid increase in growth, but, as a rule, this increase did not survive the second cutting, and later in the season the treated plots showed a depressed yield following on the use of the sulphate of ammonia, In several cases during the third year, the nitrogen plots were showing considerably weakened swards as a result of the previous applications, and they did not respond as usual to the spring dressing. In some cases this weakened growth appeared to be due to the suppression of the clover, but a similar effect was noticed on pastures which were mainly rye-grass.

With the advent of the intensive rotational grazing system, particular interest was given to the possibilities of stimulating the growth of pasture by applications of nitrogenous fertilizers. It was considered then that under this system, on strongly growing pastures where the growth of a pasture had been further stimulated by regular applications of fertilizer, the drain on the soil nitrate supply would be very heavy and a nitrogen deficiency would result. It was suggested that under Victorian conditions soil temperatures usually were sufficiently high to promote nitrification at a rate capable of keeping pace with normal pasture requirements, and that it would be on strongly-growing pastures only that the soil nitrogen supply would become exhausted.

Experiments were begun at Darnum in 1929 to test this theory, and later similar work was commenced at Colac and Warragul. The outcome of these trials has been that the poorer pastures have given the greatest response to sulphate of ammonia and the strongly-growing pastures have shown little response. Apparently the strongly-growing winter pastures are able to make this vigorous growth by virtue of the fact that there is an ample natural nitrogen supply in the soil, and the comparatively small additional amount supplied by the usual dressing of sulphate of ammonia is too small to encourage any further material growth. On the other hand, with the poor pastures the soil nitrogen supply is limited, and during the late autumn and early spring periods applications of nitrogenous fertilizers give a sharp increase in growth (See Fig. 5). This increased growth soon results in the temporary small surplus of nitrogen being exhausted, and the stimulus seldom survives the second grazing.

It has been usual to find that where sulphate of ammonia has given an increase in growth, this has been followed by a period of depressed growth, during which time the treated plots make weaker growth than the adjacent check plots. This depression lasts for quite a long time, and very appreciably offsets the value of the stimulated growth. (See Table 3.)

On the red hill country of Gippsland, nitrogen has given a good response on pastures which are usually characterized by very poor winter growth, and where used in conjunction with lime the pasture has been materially improved.

Shortly after the experimental work on nitrogen was commenced, trials were begun to ascertain the effect of applying nitrogen to pastures at various times of the year. At Colac, Darnum and Warragul, dressings of sulphate of ammonia were applied to different plots at intervals throughout the year. It was found that a response to nitrogen dressings could be obtained at any period of the year, providing the pasture had an adequate supply of soil moisture. When growth is vigorous the response is most rapid, but is of short duration; conversely, when growth is slow the response, though not so marked, is more prolonged. The most satisfactory responses have been obtained from early spring dressings, and these are most marked in seasons when the spring growth is slow in starting. The responses from late autumn dressings are dependent on the weather conditions experienced at that time, and consequently the results are rather uncertain.

The repeated use of nitrogen on the pastures has had a marked effect on the botanical composition of some of the swards. The clovers usually are burnt, and where they have been subjected to the competition of the taller-growing grass the repeated use of sulphate of ammonia, in some cases, has almost eliminated them. Most of our pastures depend on the presence of clovers for the maintenance of vigorous growth, and their suppression has had an adverse effect on the productivity of the sward. The occasional use of sulphate of ammonia in the early spring, in order to stimulate weak rye grass, may be of benefit, particularly if there is an abundance of clover present, but its repeated use on the same field will eventually lower production.

Rearing Foals and Calves

By

R. J. de C. Talbot, B.V.Sc., Senior Veterinary Officer.

A SUCCESSFUL farmer must be a competent breeder, and this means, among other things, that he has the ability to rear successfully the young animals born on the farm. Mortality among foals and calves on some properties is very much higher than it should be, and in many cases, this is due to carelessness and lack of appreciation of what the young animals require.

It must be admitted that, quite apart from the pleasure which should attend the rearing of one's own stock, there is the commercial aspect to be considered. Undoubtedly it is cheaper to rear good foals and calves than it is to buy them, and, again, by breeding their own heifers for herd replacement, dairy farmers are lessening the risk of introducing contagious diseases into the herd. Such diseases as tuberculosis, mastitis, and contagious abortion usually are brought into a herd by newly purchased cows or heifers. If foals are bred from sound stock, then it may reasonably be expected that they will not develop, in later life, such hereditary diseases as ringbone, side bones, or spavin, to mention a few only.

The care of the mare or cow prior to the birth of the young animal is of the utmost importance. It is difficult to lay down a set of hard and fast rules, but they should be directed along common-sense lines.

A draught mare may be given steady work up to a few days before foaling, in fact she usually is all the better for it. Walking pace should not be exceeded, and any strain or strenuous work should be avoided. Shaft work is associated generally with the possibility of accident or over-exertion, and in consequence mares heavy in foal never should be exposed to this risk. A liberal supply of good quality food is needed, and good chaff and oats are usually necessary to supplement grazing.

It is essential that a cow be dried off some time prior to the birth of the calf, and when dry she should not be turned out to some back paddock where nothing better than native grasses is available. A cow heavy in calf requires good nutritious food, and plenty of it, for if she is in poor condition this will be reflected in the calf when it is born.

In the majority of cases little or no attention is entailed by the arrival of a strong foal or calf; in fact animals do better when left to themselves, providing all is going well. Keep pregnant animals under close observation, but do not interfere unless it is absolutely necessary.

The first natural flow of milk is termed colostrum or beestings. It differs very much in composition from normal milk, and is absolutely essential to the well-being of the young animal. The flow of colostrum lasts for the first few days after calving, and it contains an active principle which has a specific cleansing effect on the mucous surface of the alimentary tract of the young animal. It is laxative in its effect and frees the bowel from all pre-natal accumulations. It is rich in growth-producing ingredients, and has the effect of stimulating and bringing into activity the fermentative and digestive functions which are essential to growth and development. Calves

and foals which do not receive colostrum at birth are liable, later on, to become affected with "scours" and other gastric troubles.

There are certain fundamental differences in the rearing of foals and calves. With regard to foals breeders should carefully observe the maternal instinct of the mare and the condition of the foal. The diet of the dam must be watched carefully, because injudicious feeding will be reflected very quickly by the foal. Scouring is due frequently to the mare receiving damaged or musty food or foul water. If the mare is on good pasture, the flow of milk should be well maintained, but if there is any tendency for either the foal or mare to fall off in condition, then the grazing must be supplemented by a liberal ration of chaff, oats, and bran.

If the foal is constipated, a tablespoonful of glycerine may be given, and if this fails to achieve the desired result, a tablespoonful of castor oil should be administered.

A month's rest usually is sufficient before draught mares are put into work again. When at work the foal should be allowed to remain handy, so that it can receive a drink at convenient intervals.

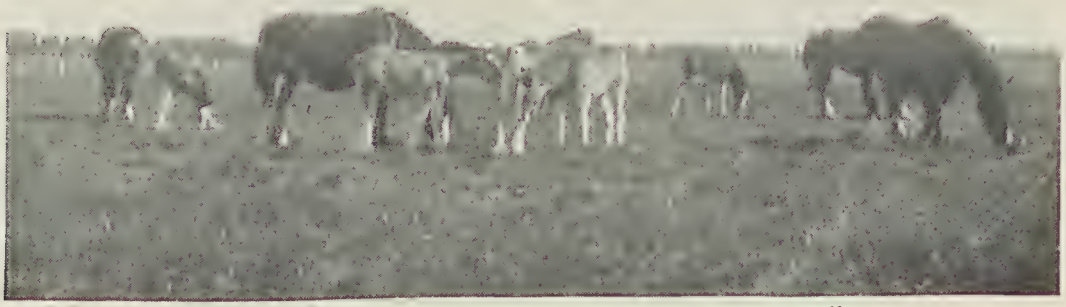
The usual time for weaning is at about five or six months of age, but before this the foal has already begun to graze, and this grazing should be supplemented by a ration of crushed oats. After weaning, the foal should be put into a good, well-sheltered paddock, and should receive a liberal supply of chaff and crushed oats.

Supplementary feeding for foals is desirable.

Hand-raising of Foals.

It sometimes happens that the mare is incapable of producing milk, or she may die, and in these cases the foal must be reared by hand. It is important that the difference between cow's and mare's milk be understood. Cow's milk requires to be modified very much before it is fit to be used as a substitute for mare's milk. The proportions of fat, acid, and curd in cow's milk are largely in excess of those in mare's milk, while the proportion of sugar is lower. More water and sugar therefore have to be added to make it suitable for the foal. The mixture should be made up by mixing three-quarters of a pint of cow's milk, one-quarter of a pint of lime-water, and three-quarters of an ounce of sugar, which should, if possible, be sugar of milk rather than ordinary sugar.

The very young foal should receive not more than a pint at each feed, but it should be fed every few hours, and the milk must always be



Foals on good pasture at the State Research Farm, Werribee.

Care of foals gives healthy yearlings.

given at blood heat. Foals soon learn to drink from a bucket, although at the beginning a feeding bottle may be necessary.

Week by week the milk diet is strengthened by reducing the quantity of added water, until by the third or fourth week whole milk is being given. The addition of sugar should be continued.

Before being turned out after weaning, foals should be handled and taught to lead. Patient and intelligent coaxing are necessary to inspire confidence.

Calf Rearing.

Only rarely in Australia are dairy calves reared, either on their own dams or on foster mothers, although it is not uncommon on dairy farms in England to find several cows of a herd each rearing three or more calves. However, hand-feeding is the common practice in this country, and it is therefore a question of considerable importance on every dairy farm.

The usual procedure, is to remove the calf from the dam before it has had time to suck. If this is done, the cow will fret less and the calf learns to drink very much quicker. It is of the utmost importance that the calf should receive, for the first few days after birth, the first milk or colostrum of the dam which, as explained previously, contains certain nutritive and laxative properties essential for its health, and which are very difficult to supply in any other way. When colostrum is not available, as sometimes occurs owing to an accident to the cow at calving time, a substitute may be prepared for each feed by whipping up an egg with half a pint of warm water, adding half a teaspoonful of castor oil and stirring this mixture into a pint of warm milk.

Milk fed to calves should always be at blood heat; but do not feed it hot, nor allow the calves to over-drink. The amount given at each feed should be from $1\frac{1}{2}$ to $2\frac{1}{2}$ quarts, and at least three feeds must be given daily until the calf is about eight weeks old. As the calf becomes older twice a day feeding is the usual practice, but on no account should gorging be permitted. Watch the calves at feeding time for any evidence of over distension of the stomach.

The provision of small bails in which the calves are taught to "bail up" at feeding time is to be commended, because, not only does it ensure that each calf receives its full ration, but also gives training in "bailing up" which will prove of value later on when the calves become heifers.

For the first three or four weeks the calves should receive whole milk, after which time a small quantity of the whole milk is replaced by separated milk, the amount being increased gradually until the calf is not receiving any whole milk. Before the diet consists wholly of separated milk it will be necessary to add a butter-fat substitute, the most common being linseed meal porridge, and/or cod-liver oil. Linseed porridge is made by mixing one quart of ground linseed meal with one gallon of boiling water. This

Calves receiving early training in "bailing-up".

porridge always should be well boiled and never kept for any length of time. Calves soon become accustomed to cod-liver oil, and it is an excellent substitute for butter-fat, but must be always of the best quality.

The following calf dietary, which is somewhat similar to that drawn up by the British Ministry of Agriculture, is recommended :—

First Week.—Warm milk from the calf's own mother, three times a day, commencing with about one quart and increasing to 1½ to 2 quarts at each meal by the third day.

Second Week.—Two quarts of warm new milk (not necessarily from its own mother) three times a day.

Third Week.—Two pints of new and three pints of separated milk, with half a pint of linseed porridge or half a tablespoonful of cod-liver oil, three times a day.

Fifth Week.—Three quarts of warm separated milk, with one pint of linseed porridge or one tablespoonful of cod-liver oil, three times a day. Some green picking and crushed oats placed in a trough should be available for the young animal to eat at leisure.

Ninth Week.—At this stage the midday meal can be omitted. About four quarts of separated milk are given twice daily, the ration of crushed oats and grass hay is increased, and at midday a small quantity of linseed cake, or some similar food, is made available. The milk ration should remain the same until about the twenty-fourth week, after which it is gradually discontinued. During this time the supply of crushed oats and hay or chaff is increased.

The important points to remember when rearing calves are :—(1) The feeding should be at regular intervals. (2) All feeding troughs and milk storage utensils must be kept scrupulously clean and frequently sterilized, either by being boiled, or by the application of steam. (3) A good grazing pasture and a satisfactory water supply should be available. (4) All diet changes must be gradual.

Ailments in calves are most commonly due to some digestive derangement, and this usually is brought on by lack of attention to the above four points. One of the first signs that a calf is not "doing well" is loss of appetite, therefore whenever a calf hesitates to take its milk, immediately administer a tablespoonful of castor oil shaken up with twice this quantity of hot water.

The successful rearing of foals or calves requires little more than attention to detail and the application of common-sense methods; but it is these which count most, and the breeder who is prepared to go to a little trouble with his young stock will be well repaid.

Contented calves in a clean well-grassed paddock.

Irrigated Pastures

Rate and Frequency of Watering Tests

By E. T. Beruldsen, B.Sc. (Agric.), and A. Morgan, B.Agr.Sc.

A general view of the Irrigated Pasture Tests. (Rate and Frequency of Watering Tests in left background.)

INCLUDED in the irrigated pasture investigations carried out at the State Research Farm, Werribee, is a test to determine the influence of varied rates and frequencies of irrigation on the character and productivity of the pasture. An area of 2⅔ acres is divided into nine bays, one of which is unirrigated, while the others are given quantities of water ranging from 18 to 36 inches per acre per annum. The average annual rainfall at Werribee is 19·2 inches.

The arrangement of the plots is as follow :—

1. Six waterings of 3 inches.
2. Six waterings of 4 inches.
3. Six waterings of 5 inches.
4. Six waterings of 6 inches.
5. No irrigation.
6. Five waterings of 6 inches.
7. Four waterings of 6 inches.
8. Three waterings of 6 inches.
9. Eight waterings of 3 inches.

During the 1929–30 and 1930–31 seasons the plots were cut at the grazing stage with a motor mower. The results obtained from these mowings are recorded in the April, 1932, issue of this Journal.

At the conclusion of two years of regular mowing, it was decided to give this test a spell from mowing, and with the object of rehabilitating the grasses in the sward it was intended that the plots should be allowed to grow to the meadow hay stage. After the meadow hay had been taken off, the plots were to be grazed intermittently with sheep.

The final cut with the motor mower was completed on 27th June, 1931. Normally, the plots would not have been cut for hay till November of that year. However, in two months' time, when a luxuriant growth of herbage had developed on all plots, the idea had been formulated of testing out our sampling technique (reported in (1) and (2)) on these plots and, if possible, to compare the relative production of the plots under grazing conditions with the results obtained by regular mowing with a motor mower during the seasons 1929–30 and 1930–31. (3)

Accordingly, a uniformity test of all plots was carried out from 5th October, 1931, to 10th October, 1931, 99 samples of 8 square links each being cut with the hand-shearing machine on each plot, and a statistical analysis of the results

TABLE 1.—DETAILS OF GRAZING.

Grazing Commenced.	Grazing Completed.	Number of Days.	Number of Sheep.	Sheep-days.
10.10.31	13.10.31	3	212	636
6.11.31	7.11.31	1	112	688
7.11.31	10.11.31	3	192	
28.11.31	1.12.31	3	136	408
15.12.31	18.12.31	2·5	274	685
7.1.32	8.1.32	1	746	746
26.1.32	27.1.32	·75	738	1,300
27.1.32	28.1.32	1	747	
19.2.32	22.2.32	3	243	729
12.3.32	14.3.32	2	375	750
16.4.32	19.4.32	3	349	1,047
21.5.32	24.5.32	3	156	468
2.7.32	5.7.32	3	103	309
30.7.32	2.8.32	3	481	1,555
2.8.32	3.8.32	1	112	
Sheep-days for period of sampling ..				9,361
				= 9·3 sheep per acre.

Period under review—27.6.31 to 4.8.32 = 404 days.

was made. As a result, it was decided to cut 14 samples before grazing, and 17 samples after grazing on an organized scatter from an area of 8/55th acre on each plot. While it would have been desirable to cut a greater number of samples at each grazing, the extra work involved in cleaning the grass, &c., was prohibitive. The experiment was intended to be more of an exploratory character, rather than to provide an extremely accurate measurement of the production of each plot.

Except for those cut before the first spring grazing, the samples from each plot were bulked, dried, cleaned, and a complete fodder analysis of the cleaned and dried herbage was obtained. No extraneous matter being in the herbage before the first grazing, the produce at that time was weighed green.

The plots were yield-sampled and grazed over a period of 404 days from 27th June, 1931, to 4th August, 1932. The details of the grazing are shown in Table 1. It must be understood that the plots were not separated by fences and grazed separately, but that a large number of sheep at each grazing had access to all the plots simultaneously. Several complications arising from this procedure will be discussed later.

Incidence of Rainfall and Irrigations.

Details of the rainfall and of the irrigations are shown in Fig. 1 and Table 2 respectively. It will be seen immediately that an unusual combination of circumstances arose, in that the schedule of irrigations was not completed in the case of the frequently watered plots, while the incidence of the rainfall was abnormal for the year. Naturally the first-mentioned fact is bound up with the latter. Except for December and January, the summer rainfall was exceptionally high and this reacted favorably on the production of the infrequently watered plots. The frequent heavy rainfalls throughout the late summer and autumn from the beginning of February onwards necessitated the curtailment of the second last watering and the omission of the final watering in the case of the frequently watered plots. Although there was a high summer rainfall in the previous season 1930–31—actually the total rainfall for 1930–31 being greater than that for 1931–32—a period of comparatively low rainfall during March and April of that year permitted the completion of the schedule of waterings. (3)

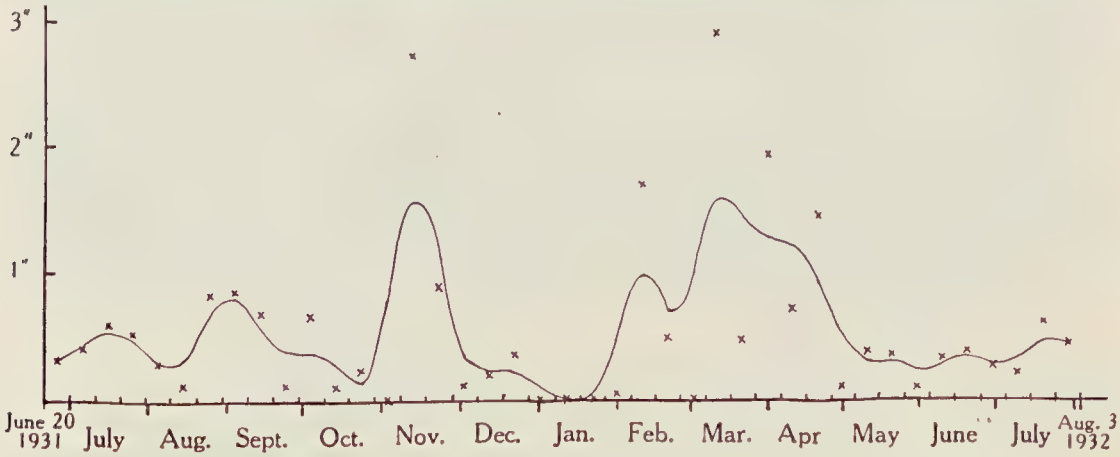


Fig. 1.—Showing the abnormal rainfall at Werribee for the period under review.

TABLE 2.—RATE AND FREQUENCY OF WATERING TESTS.—RECORD OF WATERING.

Period.	Bay 1.	Bay 2.	Bay 3.	Bay 4.	Bay 6.	Bay 7.	Bay 8.	Bay 9.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
20.10.31 to 24.10.31 ..	3·0	4·0	5·0	6·0	6·1	6·1	6·1	3·0
2.12.31 to 6.12.31	3·0	4·0	5·0	6·0	6·0	..	..	3·0
19.12.31 to 24.12.31 ..	3·0	4·0	5·0	6·0	6·0	6·0	6·0	3·0
8.1.32 to 9.1.32	..	..	..	..	..	..	..	2·8
11.1.32 to 16.1.32	3·1	4·0	5·1	5·9	5·9	5·9	..	..
18.1.32 to 20.1.32	..	..	..	..	..	..	..	3.2
9.2.32 to 15.2.32*	2·9	4·0	5·0	5·2	5·1	4·9	5·5	2·9
3.3.32 to 5.3.32	..	..	..	..	..	..	..	3·1
Totals	15·0	20·0	25·1	29·1	29·1	22·9	17·6	21·0

* This watering period curtailed by heavy rain.

NOTE.—It was intended to give a final watering to Bays 1–4 commencing 7·3·32, but heavy rain intervened and prevented any further irrigation for the season.

TABLE 3A.—TOTAL AMOUNTS OF DRY MATTER EATEN BY SHEEP AT EACH GRAZING DURING 1931–32.

Plots mown last on 27.6.31 (results in pounds per plot of 8/55th acre).

Number of Grazing.	Sampled before Grazing.	Sampled after Grazing.	Treatment (Scheduled).								
			Six waterings of 3 inches.	Six waterings of 4 inches.	Six waterings of 5 inches.	Six waterings of 6 inches.	No. Irrigation.	Five waterings of 6 inches.	Four waterings of 6 inches.	Three waterings of 6 inches.	Eight waterings of 3 inches.
1	5.10.31 to 10.10.31	13.10.31	168	91	103	49	195	187	403	447	278
2	5.11.31	10.11.31	51	257	87	58	51	35	70	34	44
3	27·11·31	1·12·31	51	50	53	21	*	91	44	24	34
4	15.12.31	18.12.31	114	48	190	*	18	77	53	81	90
5	6.1.32	9.1.32	13	38	35	23	*	20	26	*	*
6	26·1·32	28·1·32	44	107	85	82	*	41	*	*	*
7	19.2.32	23.2.32	17	37	87	101	15	55	70	23	113
8	11.3.32	14.3.32	14	92	21	105	16	57	72	70	81
9	15.4.32	19.4.32	84	67	72	40	68	73	62	50	40
10	20.5.32	24.5.32	62	57	77	52	24	63	83	70	56
11	1–2.7.32	5.7.32	32	21	36	27	24	24	65	38	15
12	29.7.32	4.8.32	58	48	38	34	29	17	39	70	34
	Totals	..	708	913	884	592	440	740	987	907	785

* No "significant" amount eaten.

In view of the above facts, the results obtained during 1931–32 are not strictly comparable with the mowing results of the two previous seasons. However, it is considered that, as the differential watering treatment had been carried out over a period of six years, the poorer plots during previous years would not recover entirely under the abnormally favorable conditions during 1931–32. Also, the results are valuable in providing a sequence of information obtained during three seasons of widely varying climatic conditions.

TABLE 3B.

Grazing Period.	Mid-date of Grazing.	Number of Days since last Grazing (mid-date to mid-date).
1	12.10.31	107
2	8.11.31	27
3	29.11.31	21
4	16.12.31	17
5	7.1.32	22
6	27.1.32	20
7	21.2.32	25
8	13.3.32	21
9	17.4.32	35
10	22.5.32	35
11	3.7.32	42
12	1.8.32	29

Period under review from 27.6.31 to 4.8.32 = 404 days.

Total period between samplings before and after grazing = 45 days = 11·1 per cent. of total period.

Yields of Herbage eaten by the Sheep.

The details of the amounts of herbage eaten from each plot at each grazing are shown in Tables 3A and 3B, while the production for the period for each plot is shown in Table 4.

Cutting yield samples with a hand-operated shearing machine.

The extraordinary variability of the amounts eaten from each plot at any particular grazing will be noted. Our field observations record the fact that this phenomenon was independent of the amount of herbage offering on each plot. Before the ninth grazing in April, 1932, the herbage on the "No Irrigation" plot consisted almost entirely of a fairly uniform growth of marshmallows from 1 foot to 18 inches high. When the sheep were admitted to the field they effectively stripped the leaves and tips of stems from these marshmallows before even touching the luxuriant growth of grass and clover on the irrigated plots. Again, a plot which was comparatively neglected at one particular grazing might be intensely grazed at the succeeding grazing, and vice versa.

At times the amount of grazing of certain plots was so slight that the sampling method was not sufficiently accurate to measure the

TABLE 4.—TOTAL PRODUCTION FOR THE PERIOD.

(lb. dry matter per plot of 8/55th acre.)

Treatment.	Amount Eaten.	Amount left after last Grazing.	Total Amount Produced.
Six waterings of 3 inches	708	232	940
Six waterings of 4 inches	913	231	1,144
Six waterings of 5 inches	884	221	1,105
Six waterings of 6 inches	592	264	856
No irrigation	440	125	565
Five waterings of 6 inches	740	179	919
Four waterings of 6 inches	987	129	1,116
Three waterings of 6 inches	907	134	1,041
Eight waterings of 3 inches	785	70	855

amount eaten. In Table 3A these results are denoted by an asterisk. As far as the "No Irrigation" and the infrequently watered plots were concerned, this result was the outcome of little or no growth having occurred on the plots since the previous grazing owing to dryness. In the case of the "six waterings of 6 inches" and the "eight waterings of 3 inches" plots, the growth had been restricted at these times through excessive moisture caused by heavy rain succeeding irrigation. Also, throughout the period it was observed that the "eight waterings of 3 inches" bay was nearly always intensely grazed, and with comparatively short periods between grazings associated with a short growth of herbage it was almost impossible to measure accurately the amount eaten by the sheep. It is admitted here that to accurately measure production of herbage under grazing conditions, the plots should be grazed separately and a sufficiently long period should elapse between grazings to permit the herbage to reach a stage of growth suitable for sampling by this method. Some plots, notably the "six waterings of 6 inches," were merely topped at each grazing, and such plots soon assumed a tussocky appearance. This must have detracted from the productive powers of these plots.

To illustrate the effect of this selective grazing consider the second column of results in Table 4. The amounts of herbage left on each plot after the most intensive grazing of the series are illuminating. Although no botanical surveys were carried out during the season we know from previous results and from observation that the herbage on the infrequently watered plots contained a large proportion of annual species, such as subterranean clover, and these evidently were more appreciated by the sheep than the perennial species white clover, cocksfoot, and rye grass on the frequently watered plots at that time. Although practically no annual species were present on the "eight waterings of 3 inches" plot, the short bite always present on this area after the first two or three grazings, was appreciated by the sheep.

The superiority of two acre-feet of water over other amounts of irrigation water are shown in Tables 3 and 4. Considering the amounts eaten (Table 3A), four waterings of 6 inches is slightly superior to six waterings of 4 inches, reversing the results obtained in previous years. However, considering total production from Table 4, six waterings of 4 inches has the advantage.

The comparison of "amounts eaten" and "amounts produced" under grazing conditions during season 1931–32, with yields obtained by close mowing during seasons 1929–30 and 1930–31 are presented in Table 5. As the time the sheep were grazing on the plots constituted 11.1 per cent. of the total period, and as there was no possible measurement of the growth which occurred during the grazing period, it is obvious that before a comparison of the above nature can be made some correction should be applied to the production figures obtained by yield-sampling. A correction factor of 10 per cent. (5) has been adopted by other workers in grazing experiments, and, as 11.1 per cent. approximated this figure, the adjusted yields, as well as the actual yields, are shown in the last two columns of Table 5.

TABLE 5.—COMPARISON OF "AMOUNTS EATEN" AND "AMOUNTS PRODUCED" UNDER GRAZING CONDITIONS DURING SEASON 1931–32 WITH YIELDS OBTAINED FROM CLOSE AND REGULAR MOWING DURING SEASONS 1929–30 AND 1930–31.

(lb. of dry matter per acre.)

Treatment.	Mowing.*		Grazing.		Corrected Amount.	
	1929-30.	1930-31.	Amount Eaten, 1931-32.	Amount Produced, 1931-32.	Eaten, 1931-32.	Produced, 1931-32.
Six waterings of 3 inches ..	6,725	8,455	4,868	6,463	5,408	7,180
Six waterings of 4 inches ..	9,203	9,885	6,277	7,865	6,974	8,738
Six waterings of 5 inches ..	8,737	9,788	6,078	7,597	6,753	8,440
Six waterings of 6 inches ..	9,125	9,351	4,070	5,885	4,523	6,538
No irrigation	2,907	3,755	3,025	3,884	3,361	4,315
Five waterings of 6 inches ..	7,247	8,656	5,088	6,318	5,653	7,019
Four waterings of 6 inches ..	7,069	9,100	6,786	7,673	7,539	8,525
Three waterings of 6 inches ..	5,759	8,580	6,261	7,157	6,956	7,951
Eight waterings of 3 inches ..	8,323	9,468	5,397	5,878	5,996	6,530

* Last grazing 6th May, 1929.

TABLE 6.—RELATIVE EFFICIENCY OF WATER SUPPLIED.

Treatment.	Rainfall + Irrigation.			Lb. of Dry Matter Produced or Eaten per inch of Water Used.			
				Mowing.		Grazing, 1931–32.	
	1929–30.	1930–31.	1931–32.	1929–30.	1930–31.	Eaten.*	Produced.*
	Inches.	Inches.	Inches.				
Six waterings of 3 inches ..	38·22	43·09	38·06	176	196	142	189
Six waterings of 4 inches ..	44·22	49·09	43·06	208	201	162	203
Six waterings of 5 inches ..	50·22	55·09	48·16	174	178	140	175
Six waterings of 6 inches ..	56·22	61·09	52·16	162	153	87	125
No irrigation	20·22	25·09	23·06	144	149	146	187
Five waterings of 6 inches ..	50·22	55·09	52·16	144	157	108	134
Four waterings of 6 inches ..	44·22	49·09	45·96	160	185	164	185
Three waterings of 6 inches ..	38·22	43·09	40·66	151	199	171	196
Eight waterings of 3 inches ..	44·22	49·09	44·06	188	193	136	148

* Results calculated from adjusted total amount eaten and produced figures in Table 3.

Allowing for different seasonal conditions, it would appear that production harvested by the grazing animal is similar to that obtained by close mowing. There is no evidence to show that from the type of pasture present, increased production would result from grazing as compared with mowing. The results are interesting when compared with those of Professor A. E. V. Richardson from an irrigated pasture at Wood's Point, South Australia (4). Professor Richardson records an increase of 34 per cent. obtained by grazing an irrigated pasture as compared with mowing. While the Wood's Point pasture was dominantly rye-grass, our pasture type is dominantly white clover, and for this reason we would not expect any appreciable increase in production due to the animal droppings and urine (7).

Pastures before grazing.—A, Suitable; B, Unsuitable for the grazing sampling method.

Relative Efficiency of the Water Supplied.

A study of the results presented in Table 6 reveals that the "six waterings of 4 inches" plot again demonstrated its superiority over the other plots in respect of the efficiency of the water supplied. Since this is the crucial test, there is no doubt of the corroboration of the results obtained by mowing. An interesting feature of the results obtained from this plot is the consistent high production of herbage per inch of water supplied through three seasons of very variable conditions.

The influence of the late summer and autumn rainfall in increasing the efficiency of the moisture in the case of the infrequently watered plots again is demonstrated clearly, as it was in season 1930–31.

The influence of excessive moisture in decreasing the efficiency per unit value of water supplied is demonstrated in the case of the "six waterings of 6 inches" and to a lesser degree in the "eight waterings of 3 inches" plots. It is considered that the effect in the latter plot has been mostly accidental, as in a normal season this method of watering approaches the ideal.

Chemical Composition of the Herbage Eaten.

As the samples of dried herbage obtained by the shearing method were contaminated unavoidably by soil dust even after extraneous matter had

Left, grazing and yield sampling; Right, motor-mowing. These methods of measuring the yield both gave similar results.

been removed, it was necessary to compute the fodder analyses on a silica-free basis. At the first grazing the herbage was weighed green and was not analysed. Therefore, the results presented in Table 7 are the weighted averages for a period excluding the first spring grazing in October, 1931. It is not intended that the results should be taken as exact analyses of the herbage eaten by the sheep. Obviously they disregard the growth occurring while the sheep were actually on the plots. However, they serve as a sufficient index of the relative fodder value of the herbage obtained from the different plots. It must be remembered that the selective grazing exercised by the sheep, where some plots were merely topped and others well-grazed at one grazing and perhaps vice versa at the next grazing, gave figures for the fodder value of the herbage eaten off each plot which varied widely from the figures obtained on the analysis of mowed herbage at any particular time. The herbage *eaten* by the sheep on all plots was evidently of a very high nutritive value, and was always higher in protein and lower in fibre than the total herbage offering before grazing and after grazing, showing that the leafy portion of high protein content was selected.

The very high protein and ash contents, and the very low fibre and nitrogen-free extract contents of the herbage from the "No Irrigation" plot are significant. For example, the analysis for the grazing period in April, 1932, when, as already mentioned, the sheep concentrated on the "No Irrigation" plot, showed a very high silica-free ash figure both before and after grazing. Also, the leaves and stem-tips of the marshmallows eaten at that grazing and two subsequent grazings were very low in fibre content. This might be an indication of palatability and would explain the decided preference of the sheep for "succulent" (6) herbage on this plot at that time.

TABLE 7.—SHOWING PERCENTAGE COMPOSITION OF TOTAL HERBAGE EATEN (EXCLUDING FIRST GRAZING).

(Results on silica-free basis.)

Treatment.	Protein.	Crude Fibre.	Silica-free Ash.	N-free Extract + Fat.
	Per cent.	Per cent.	Per cent.	Per cent.
Six waterings of 3 inches	25·6	19·1	8·1	47·2
Six waterings of 4 inches	28·0	18·6	7·7	45·7
Six waterings of 5 inches	28·8	18·6	8·5	44·1
Six waterings of 6 inches	30·8	19·3	7·6	42·3
No irrigation	35·8	10·6	14·9	38·7
Five waterings of 6 inches	30·3	15·2	8·6	45·9
Four waterings of 6 inches	26·3	17·3	8·2	48·2
Three waterings of 6 inches	27·8	19·2	7·9	45·1
Eight waterings of 3 inches	23·2	18·8	7·0	51·0

Further, the herbage on this plot was mainly a succession of spasmodic and *rapid* growths of succulent annual species in response to intermittent falls of heavy rain. It is characteristic that herbage of this nature has a high protein content. The low protein value for the "eight waterings of 3 inches" plot may be partly explained by the unfortunate combination of circumstances adversely affecting this plot.

Discussion of the Experimental Method.

As this is the first report on an experiment at Werribee where the "yield-sampling and grazing" method has been employed, it appears opportune to remark on the relative advantages and disadvantages of the method itself, although it is intended to do this more fully in connexion with the yield-sampling carried out on the Rotational Grazing Trials. It is considered that the method has proved of great value in ascertaining the production of pasture under natural conditions of harvesting, viz., by grazing.

The amount of work involved in drying and cleaning the herbage samples is the worst feature of the method, even when such aids as an electric fan and blower tube are employed to separate the grass and dirt, after sieving, into suitable fractions. There is no doubt that if it had been possible to cope more effectively with the cleaning problem, it would have been possible to cut more samples and thus increase the accuracy of the sampling. This is an important feature, since owing to the errors involved, the samplings before and after grazing occasionally indicated that the sheep had put a small amount of herbage on a plot instead of eating it off. However, these negative results were not statistically significant. In seven cases out of nine they were due to very poor growth, and in two cases, to the neglect of the herbage, on that particular plot, by the sheep during one or two grazings. The results were uniformly satisfactory when a good growth was present before grazing and when the plot was properly grazed, and consequently the method appears to be of most value when the plots are not too frequently grazed and when they are grazed separately.

After the spring flush of growth, a minor complication arose through neglected herbage gradually dying off and being trodden into the ground by the sheep, thus introducing a slight error. This could have been eliminated by the use of a horse-mower fitted with a catcher.

A test of sub-sampling of the dried herbage in order to reduce the work involved in cleaning did not give satisfactory results, except for the material which passed through the finer meshed sieves.

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Dairy Farm Competition

State-wide Contest

By W. J. Yuill, Senior Dairy Supervisor

Mr. R. T. Mitchell's Jersey grade herd at Merino.

DESPITE the continuance of low prices and the consequent lack of enthusiasm in the dairy industry, there were actually more entries for the 1934 Farm Competition of the Victorian United Cow Test Association than were received in its first year. Owing to floods and other reasons, however, some competitors were compelled to withdraw at the last moment. Since the inauguration of this competition, field days have been held on upwards of 200 farms of contestants; these have been attended by approximately 20,000 dairy farmers and, in this way, the information gleaned from the competition has been disseminated. In the competition, which is a dairy farm one in every sense of the word, a definite effort has been made to consider all farm activities and compare those on one farm with those on another. Features for which main points are awarded are the layout of the farm, the production of butter-fat in relation to farm value, the net returns, and the carrying capacity of the farm.

In the section dealing with breeding and production, the quality of the sire, the herd, and the young stock are considered, and also the control of the herd-sire. In sub-section 9, allowances were made for all junior cows in the herd. The herd production (with allowances) is called "nominal butter-fat," and points were awarded according to production for every £100 farm value. The variation ranged from as high as 500 lb. on twenty farms to lower than 200 lb. on three farms. One point is given for each complete 10 lb. of nominal butter-fat. In every section the awards are expressed in points.

The non-testing dairy farmer is rarely interested in the purchase of production-bred pure bulls, and he has no means of measuring the production of his individual cows. He is, therefore, ineligible to compete since the use of production-bred pure bulls and the testing of the yields from each member of a herd are two of the essential features of the competition.

A detailed account of the bases on which the competition is judged will be found in this *Journal* for July, 1934. The value of each competing farm is arrived at by the judge, the farm owner, and a local farm valuer. The figure agreed on may not be one at which the farmer will sell, for progressive farmers are rarely sellers at any price. They represent a class of men of whom Australia—and in particular Victoria—is much in need, for they are farm builders, and not farm dealers. These men have what we may term a rural outlook and a keen home sense, and their farms are practically the work of their hands; and in these all the pride of ownership is shown.

Judging the Competition.

Because of the state-wide nature of the competition it is necessary to have several judges operating at the same time. This work is carried out by the senior officers of the Dairy Division of the Department of Agriculture. Periodically judges are changed over in order that competitors may receive the benefit of different opinions. In last year's competition, five of the zones had a change of judge. In the interzone competition a special inspection is made if the scores are close enough to warrant it. This is also true of the Championship Class.

A very common difficulty in competition work is the consistent winning of the foremost places by a few men. The usual means of dealing with this position is the adoption of some sort of handicap system. The strength of the leading farms in the Victorian United Cow Testing Association dairy farm competition was generally made known to all intending entrants through the extensive system of field days already referred to. In order to give the less developed farmer a chance, and at the same time retain the interest of former successful competitors, a Championship Class has been introduced for which all former zone winners may compete. After having reached the standard of a zone winner a farmer may not compete for any section prizes; he may, however, be included as one of the "big four" of the interzone competition for the C.F.C. Shield. He may also compete for the first and second class certificates donated by the Royal Agricultural Society for each zone; further, he may compete for the Champion and Reserve Champion farm prizes.

The Awards.

The Council has been ably supported by certain business firms in the carrying on of the competition. Originally it was made possible by the generous help of the Commonwealth Fertilizers Co., and a silver-mounted blackwood shield was given for an interzone competition awarded on a comparison of the aggregate scores of the leading four contestants of each zone. The names of the leading four are inscribed on this shield, while each of them receives a handsome miniature as a memento of the occasion. Originally ten silver cups were provided, one for each of the winning farms in the several zones. But instead of cups the company now donates a half ton of superphosphate for the winning farms in Sections "B" and "F" of each zone.

Types of Farm Planning.

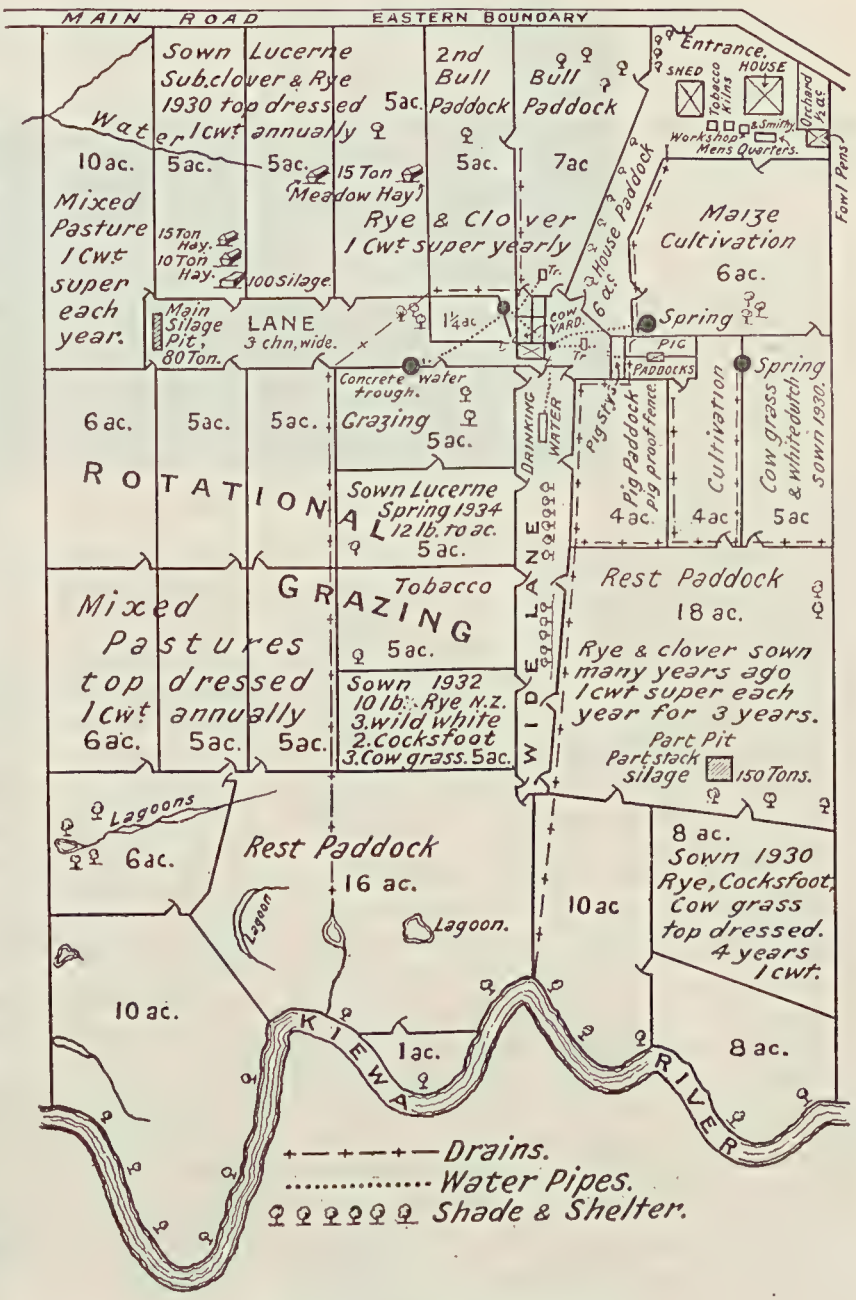
Up to 100 points are allotted for farm layout shade and shelter, while 20 points are given for an ideal water supply. On level country the usual type of farm layout is some modification of the central laneway idea, for the majority of the paddocks in such country abut on a lane. This system is highly developed on Mr. J. B. Watson's

Mr. J. A. Ford's Jersey grade herd.

farm at North Shepparton, plan of which was included in last year's report.

Throughout the hill and valley country, the laneway and accommodation or rest paddock system is largely favoured. This arrangement can be understood by studying the accompanying plan of Mr. J. A. Ford's farm. Here a system of 33 paddocks is associated with three rest paddocks and a laneway system. The main laneway is 3 chains wide; in it shelter and shade are provided as well as a permanent water supply. Some fine old redgums have been preserved and new plantations provided. Mr. Ford favours the "Candy" type of water troughs. In this system the water enters at the bottom and the level is controlled by a floating ball affixed to the lever. One of these circular troughs is 8 feet in diameter; it is situated in the laneway paddock, and provides a common watering place for all paddocks on this section of the rotationally grazed area.

Generally the windmill and overhead supply is favoured, except in the hill country, where hydraulic rams come into prominence, and in some cases also springs. Dr. and Mrs. Henderson's "Nerang" farm has a fine water system. Supplies are partly drawn from dams and partly from the King River. No less than 23 taps are provided in the home, the garden, and the farm buildings. Mr. W. J. Reid, of Murchison, has water at many points about his dwelling, lawns and gardens, and farm-steading. Mrs. Cardwell, of Eskdale, J. B. Sellars and W. J. Roach, of Narracan, and H. Roper, of Kiewa Valley, all have an efficient water service, in each case by a hydraulic ram.



Plan of Mr. J. A. Ford's Farm.

Ford, of Kiewa, Geo. Wickham and D. Horne, of Camperdown, each scored the maximum points in this section. The allotting of 90 points or over for lay-out and 15 or more points for a water system indicates that these requirements are excellently met.

Home of Mr. D. Horne, Camperdown.

The competition has been responsible for improvement in bookkeeping. The old cheque butt and bank book system is now a thing of the past. Messrs. A. Crosthwaite, J. W. Reid, R. T. Mitchell, and H. Wettenhall, each of whom has devised a very fine system, all received full points. Beautiful homes like those of Messrs. A. Crosthwaite, Ford, Horne, Wilsher, Taylor, Bligh, Sellars, Bright, Sinini, Howell, Bramby, Share, Wettenhall, and Stanlake, and Mrs. Cardwell, would not fail to impress even the casual observer. The judge, however, looks beyond the exterior, for sometimes homes with quite unpretentious exteriors possess all the amenities of a modern house. Many of the homes that were awarded over 18 points, were snugly set in an environment of gardens, lawns, and hedges, and were replete with every modern convenience to make the lot of the womenfolk an easier one. In the fruit, vegetable, and flower gardens there was a fine blending of the practical and the aesthetic. Fourteen of the entries receive 18 of the possible 20 points in this section. In section "C" the whole shed and dairy arrangements, including yards, gateways, drainage, heating apparatus, the method of cooling, and subsequent control of the product are taken into consideration. Should a competitor own a fine shed with inefficient drainage he receives due points for his shed, but is scored down for the faulty drainage. He may have a good dairy and omit cream cooling; again points will be allotted according to the merit of each section.

Messrs. D. Horne, of Camperdown, and G. Wilsher, each of the Winchelsea Association, obtained a very high standard in this section. At a field day on the former's farm visitors were greatly impressed with the dairy layout and the general standard of the farm. Twenty-three competitors were awarded 90 of the 105 possible points, eight scoring upwards of 100.

Messrs. Horne, Wilsher, and A. E. Barton, of Kiewa, each scored the maximum number of points. Zones 1 and 2 were both particularly strong in this section. An interstate visitor to the Kiewa area expressed great surprise at the unusual development of concrete in farm buildings. Not only are the shed foundations and the floors and drainage of concrete, but in some cases, notably on the farms of Ford Bros., Crosthwaite Bros., Mrs. Cardwell and, in particular, Mr. Barton, the bailing yard, the outer receiving yard, and the "walk through" are all of the same material.

The bail fittings mainly are kept clear of the floor to secure more efficient flushing with water and to allow the sun's rays onto the whole of the floor surface. A 1-h.p. steam boiler is a usual part of the dairy equipment. Steam is used for sterilizing the dairy utensils, and, in some cases, the machine pipe line.

A sound drainage system is an essential part of a shed layout. The cows should not cross the line of drainage, nor be allowed access to it.

Competition Results.

Victoria occupies only 2.97 per cent. of the total area of the Commonwealth, yet even in this small State very marked variations in seasonal conditions occur. This was a definite feature of the season under review. The Western area, and also Central and South Gippsland, suffered a lean year, whereas the North-east and Eastern

Gippsland received bounteous summer rains, and experienced a generous autumn growth of pasture and summer fodder crops.

Awards in the various Zones and Sections.

ZONE 1.

Competitor.	Association.	Total Points.
*J. A. Ford	Kiewa Valley ..	780·2
*Mrs. Cardwell	Eskdale ..	762·8
A. Barton	Kiewa Valley ..	741·7
A. Crosthwaite ..	„ „ ..	730·6
W. W. Smith	Tallangatta ..	725·1
A. D. Ford	Kiewa Valley ..	715·4
J. W. Crosthwaite ..	„ „ ..	711·6
A. H. Roper	„ „ ..	707·5

ZONE 2.

Competitor.	Association.	Total Points.
*Dr. J. L. and Mrs. I. Henderson	Millewa ..	759·2
*F. Docking	Alexandra ..	733·4
H. Lester	Swanpool ..	725·2
A. Evans	„ ..	694·9

ZONE 3.

Competitor.	Association.	Total Points.
*J. B. Watson ..	North Shepparton	766·8
*P. Freestone	North Murchison	752·9
W. Reid ..	„ „	744·7
Geo. Billingham ..	North Shepparton	698·9

ZONE 4.

Competitor.	Association.	Total Points.
*J. R. Flegg	Kerang ..	769
A. J. Beale	Murrabit ..	730
C. Schier	Cohuna ..	719·3
T. E. Bond	„ ..	710·3
T. F. Mayo	„ ..	696·3

* Zone winners in previous competitions.

The vagaries of the seasons to some extent are reflected in the points awarded for fodder reserves. Six of the farms in Zone No. 1, situated mainly in the Kiewa Valley, scored the full 50 points for fodder reserves. Each had approximately 100 tons of ensilage and hay from the previous year and had made extensive provision for the current year's needs. Mr. J. A. Ford had 350 tons of ensilage and 45 tons of hay.

ZONE 5.

Competitor.	Association.	Total Points.
J. Robinson	Woodford ..	651·1
W. H. Bligh	„ ..	631·2
G. J. Tate	„ ..	629·4
Horn and Horn ..	Warrnambool ..	624
E. Wright	„ ..	612·5
R. T. Mitchell	Coleraine ..	600·3
Mrs. E. J. McKenzie ..	Woodford ..	571
R. H. Nagle	Coleraine ..	530·4

ZONE 6.

Competitor.	Association.	Points Awarded.
D. Horne	Camperdown ..	739·2
G. Wilsher	Winchelsea ..	725·5
G. Wickham	„ ..	713·5
J. C. Taylor	„ ..	712
H. Parish	„ ..	710
W. Hannon	„ ..	685·2
J. Morris	Apollo Bay ..	655·6
W. H. Fleay	Winchelsea ..	575
L. Dunce	„ ..	499·7

ZONE 7.

Competitor.	Association.	Total Points.
R. C. Stockel	Maffra ..	673·8
W. F. Treasure ..	Sale	663·7
W. E. Johnson ..	Bairnsdale ..	617·6
E. J. Pearce	Maffra ..	610·3
Manson and Son ..	„ ..	561·5

ZONE 8.

Competitor.	Association.	Total Points.
J. B. Sillars	Narracan ..	768·1
W. J. Roach	„ ..	732·5
W. Dineen	„ ..	684·7
F. Savige	„ ..	681·2
L. C. Mayo	„ ..	680
L. Sinini	„ ..	675·3
Miss M. Wilson ..	„ ..	640·7

Only one of the entrants in Zone No. 6—last year's winning zone—obtained the maximum points for fodder reserves. A hard winter and spring had been experienced and their reserves had

been practically exhausted. Unfortunately two of the leading farms in this zone were withdrawn from the competition, and after holding the "C.F.C." shield for two years, Zone 6 has now lost it to last year's runners up, who on this occasion win the premier honour very comfortably.

ZONE 9.

Competitor.	Association.	Total Points.
G. H. Bright	Dumbalk ..	742·5
J. G. Howell	Leongatha ..	732
F. S. Bramby	„ ..	651·5

ZONE 10.

Competitor.	Association.	Total Points.
*D. and M. A. Pool ..	Lang Lang ..	746·5
*J. Share	Korumburra ..	743
H. A. Wettenhall ..	„ ..	722
J. R. Carmichael ..	Lang Lang ..	687·5
G. Stanlake	Lock	644

* Zone winners in previous competitions.

This year's "big four" come from Zone No. 1. Three are members of the Kiewa Valley, and the other of the Eskdale Association. All the winners had been associated with the competition since its inception. Mr. Ford's was the leading farm in the 1930 competition and zone winner on three occasions, while Mrs. Cardwell's entry led the zone in 1933. Mr. A. E. Barton and Mr. A. Crosthwaite have been prominent in the results of each year's competition.

There is probably no keener body of farmers in Victoria than the leading members of the Kiewa Valley Herd Testing Association. Every year they are to be found at the Annual Field Day of the Central Herd Test Council, and they have quietly brought into their farm system any reforms and changes that they have deemed worth while.

Zone Competition for C.F.C. Shield.

FIRST—ZONE 1.

Competitor.	Association.	Total Points.
*J. A. Ford	Kiewa Valley ..	780·2
*Mrs. Cardwell	Eskdale ..	762·8
A. E. Barton	Kiewa Valley ..	741·7
A. Crosthwaite ..	„ „ ..	730·6
Grand Total ..	.. ..	3,015·3

SECOND—ZONE 3.

Competitor.	Association.	Total Points.
*J. B. Watson	North Shepparton	766
*P. Freestone	North Murchison	752·9
W. J. Reid	„ „	744·7
G. Billingham	North Shepparton	698·9
	Grand Total ..	2,962·5

Champion Herd Test Farm.

First and Champion, J. A. Ford, Gundowring Kiewa Valley Association, 780·2 points.

Reserve Champion J. R. Flegg, Tragowel, Kerang Association, 769 points.

Mr. Flegg's Jersey grade herd at Tragowel. Six years' average 564 lb. butter-fat.

Breeding and Production.

There are seven sub-divisions in this section, and consistent effort is necessary if a high score is to be achieved. Only six entrants exceeded 180 points. The highest award was 195 points to Mr. J. R. Carmichael, of Lang Lang Association.

Fifty-two of the bulls inspected scored 45 or more of the 50 points allotted. The general run of the herd sires was of a very high standard. With three exceptions all the bulls were from dams with

Standard Test records. In 37 cases the dams had yielded at least 500 lb. butter-fat. Both the dam and the paternal dam of the herd sires of Messrs. R. J. Flegg, H. Parish, and E. J. Pearce had exceedingly high records. Generally these bulls are under strict control; on 43 farms 80 per cent. of the maximum score for bull control was allotted. The maximum is earned where there is a paddock or pen with permanent water, feed, and shelter, as well as a service pen.

In sub-section 12, which deals with appearance, quality, and condition of the herd, the sire and growing stock, some excellent figures were registered. Twenty-two entrants received 28 of the possible 30 points; Mr. J. A. Ford, of Kiewa, Mr. A. Evans, of Lima East, Mr. J. B. Sillars, of Narracan, and Mr. J. Share, of Korumburra, each secured full points.

In the sub-section for production, very great variations were noted. Generally, high results accrue from inferior but well-developed land where there is a high rainfall, though low costs and high returns will result from good management even on high valued farms. An average of 500 lb. of "nominal" butter-fat was reached on 20 farms.

On Mr. H. H. Roper's farm at Tawonga, at the head of the Kiewa Valley, land values are low, because of the long distance from the railway. The flats are of good quality, and splendid pastures are being developed. His grade Jersey herd of 70 cows is prominent in the Association's report each year. His farm of 200 acres is valued at £2,400. The nominal butter-fat yield for the year worked out at over 500 lb. per £100 of farm value.

A common charge against the present condition of the industry is that land values are too high. That charge is reflected in this section of the competition, and also in the section for net returns. In some instances, however, good management may result in high returns, even where high values rule. The farms of several of the entrants were valued at between £20 and £35 an acre, yet they yielded 500 lb. and more "nominal" butter-fat for each £100 of farm value.

Some farmers use a considerable amount of concentrates, and had high net returns. High returns were obtained in some cases as a result of top-dressing, which gave adequate pasture for grazing, and for fodder reserves.

An unusual instance of low land values, high concentrate cost, and exceedingly high net returns was shown on the farm of Mr. J. H. B. Morris, of Apollo Bay, where £64 was expended on concentrates. The splendid herd average of 315 lb. of actual butter-fat was made on land valued at £5 an acre. Conditions at Apollo Bay are not ideal for dairying since, apart from the distance from the railway line, the land is very steep and broken; but, as was the case with Mr. Roper, good returns were made, and the maximum number of points (50) gained. Eleven farms equalled this figure; on fourteen the average was less than 300 lb. (30 points). The lowest score was 130 lb. (13 points). On only 11 of the 58 farms was the average yield of the junior cows (with allowances) lower than that of the mature cows. Seven competitors had a growing cow for each milking cow in the herd; generally the number was about half this. The animals considered as replacements were uncalved two-year-olds and yearlings.

Pigs and Poultry.

Pigs have always been a natural adjunct to the dairy farm; poultry also comes into this category, but of course to a much lesser extent. Those farms whence all the milk is sent to a factory, and on which consequently no pigs are kept, are at a disadvantage in the competition, and an effort will be made to remove this anomaly in future contests.

Carting pressed hay.

Mr. A. Evans of Lima East presses his meadow hay in the paddock and it is stored till needed.

Twenty-seven of the entrants scored 40 or more of the total 50 points in the pig section. In awarding points, breeding stock, quality, and the housing or control are considered.

Generally some combination of the Large White breed was in evidence; other breeds such as the Middle White, Berkshire, and the Tamworth were less favoured. As in 1933, Mr. R. J. Flegg's pig returns were high. Last year they reached £400.

Mr. J. B. Watson's poultry returns exceeded £70, but generally the amounts were below £10. The Black Orpington and White Leghorn appear to be the most popular birds, with the balance well in favour of the Black Orpington.

Crops, Pastures, &c.

In this section the maximum number of points is 280.

As the majority of the competing farms are situated in districts of good rainfall, or else in the irrigation areas, it is not surprising to hear of the great development of pastures and fodder crops. Side by side with farm subdivision there has been a sound improvement in pastures. Cocksfoot and perennial rye are the general grasses used, with dutch, subterranean, alsyke, or red clovers; strawberry clover also is favoured in some places.

Sometimes the mixture is entirely of perennial plants, while on other farms an annual mixture is used on light land, and allowed to seed in early summer. This practice ensures continuous growth from year to year. In every area subterranean clover appears to have become a general standby for early feed in autumn, winter, and spring.

One of Mr. J. W. Crosthwaite's fine cows. (Note underground silo at the back).

Dr. and Mrs. Henderson have a 4-acre paddock of *Phlarius tuberosa*, which is making strong growth. Lucerne is grown in many areas, though red clover is still the "lucerne" of Central and South Gippsland. Top-dressing is now a general practice; several tons of superphosphate are used annually on the majority of farms. Japanese Millet and Soudan grass for summer and autumn grazing, and autumn sown oats for winter, are still the main soiling and grazing crops, with sorghums and maize used in a much less quantity than formerly. The making of ensilage is on the increase; grass ensilage is the commonest, but millet, sorghum, and other crops are commonly used.

Thirty-five competitors were awarded 45 of the 50 points for fodder reserves, while 25 scored 90 or more of the 100 fixed for an ideal pasture. Mr. Stockel, of Sale, and Mr. Roach, of Narracan, each scored 98 points for a wonderful sward of dense, even pasture. On many other farms there were highly developed pastures, but they lacked evenness over the whole area.

Some of Mr. Allan Crosthwaite's high-producing herd. It is the leading herd in the Kiewa Valley and on several occasions has averaged over 350 lb. butter-fat.

General Comments.

As might be expected, the size of the farms varied considerably; the smallest was 51 acres in area, the largest 370 acres; eighteen were of less than 100 acres, while eleven were over 200 acres; the average was about midway between these two figures.

Values varied from £5 an acre at Apollo Bay to £40 an acre at Sale, Maffra, and Bairnsdale. In eighteen cases they exceeded £30 an acre, while twenty were below £20. The average farm value per cow for all entrants was £75. In three cases it exceeded £100; in eight it was below £45.

Twenty-two competitors had pig returns exceeding £200; those of Mr. J. R. Flegg exceeded £400.

Eighteen competitors had returns for poultry exceeding £10. Mr. J. B. Watson's return from this source being £70. In these amounts no allowance is made for eggs and poultry used on the farm.

Winners in Each of the Ten Zones.

Details of Points Allotted.

Sections "B" to "G." (Section "A" is denoted entirely to defining Values, &c.)	J. A. Ford, Kiewa Valley, Zone 1.	J. R. Flegg, Kerang, Zone 4.	J. B. Sellars, Narracan, Zone 8.	J. B. Watson, North Shepparton, Zone 3.	Dr. J. L. and I. Henderson, Millewa, Zone 2.	D. Horne, Camperdown, Zone 6.	D. and M. A. Poole, Lang Lang, Zone 7.	G. H. Bright, Dumbalk, Zone 9.	R. C. Stockel, Maffra, Zone 7.	J. Robinson, Woodford, Zone 5.
Farm layout	100	93	95	100	92	100	95	90	96	85
Water system	20	18	20	20	20	20	19	20	18	18
Bookkeeping	19·5	15	19	18	17	19	18	16	15	12
Home	20	17	20	19·5	19·5	20	18	20	17	19
Total in "B" Section	159·5	143	154	157·5	148·5	159	150	146	146	134
Shed work	67·5	65	65	66	66	70	68	66	60	60
Dairy work	34	30	33	30	35	35	32	32	15	32
Total in "C" Section	101·5	95	98	96	101	105	100	98	75	92
Herd sire	48	45	48	48	46	45	48	50	45	40
Ancestry production	22	30	15	18	18	14	14·5	18·5	8	6
Herd production	45	49·5	50	50	50	28	23·5	37·5	46	36·5
Increase of junior over mature cows	3·2	11	2	3·3	..	25	2	19	2·1	..
Proportion of young cattle to milkers	10	16·5	14·5	18	19	7·7	30	16	6	16·7
Inspection of stock	30	26	30	28	28	26	27	28	28	23
Bull control	9	6	9	9·5	9·5	10	8	10	8	6
Total in "D" Section	167·2	184	168·5	174·8	170·5	155·7	153	179	143·7	128·2
Pig section	48	45	50	40	38	45	44	48	..	..
Poultry section	17	9	17	18	18	20	16	20	16	18
Total in "E" Section	65	54	67	58	56	65	60	68	16	18
Carrying capacity of farm	23	24	21	24·5	25·5	22	20	18·5	24·5	23
Fodder reserves	50	45	50	45	50	50	50	29	50	50
Condition of pastures	96	92	90	92	83	90	92	88	98	90
Fertilizing	100	100	100	100	100	100	100	100	100	100
Total "F" Section	269	261	261	261·5	258·5	262	262	235·5	272·5	263
Section "G"—Net return per £100 of farm	18	32	18·6	19	26·7	12·5	21·5	16	20·6	15·9
Grand Total	780·2	769	767·1	766·8	761·2	759·2	746·5	742·5	673·8	651

The majority of the competitors use upwards of a bag of superphosphate per cow. In only one instance was no fertilizer used.

Two farms had a cost for concentrates that exceeded £100, mainly for pig feed, while eleven purchased some hay.

For want of a better word, the term "net return" is used in section G. In this section the returns from the dairy, pigs, and poultry, and for stock agisted on the dairy area, are grouped; from these are deducted the costs for fertilizer, lime, concentrates, roughage, irrigation charges, and agistment, and the resulting figure is regarded as the net return.

Thirty-nine competitors had figures that were less than £20, while the extraordinary figure of £49 14s. was shown on the farm of J. H. B. Morris, of Apollo Bay. This owner used £64 worth of concentrates. His herd of 30 Jerseys put up the remarkable yield of 378 lb. of butter-fat, with allowances for junior cows. One must know the Apollo Bay country to appreciate this fine performance.

A review of the judges' reports indicates clearly that a definite "pasture sense" prevails throughout the higher rainfall area, and also on the irrigation settlements.

In the lighter rainfall districts a very considerable increase in ensilage making is noted, as much as 350 tons being stored on one farm. Many farms have upwards of 100 tons. The stack and pit methods are generally observed.

An interesting feature has been the maintenance of the essential fodder reserves, despite the steady increase of stock on many of the competing farms.

Twenty-one farms had dairy returns that exceeded £500; eight exceeded £600; three were above £700, while the highest return was over £1,000. Nineteen small farms had dairy returns below £300; the lowest was £146.

Wimmera Rye Grass

Seed Samples Wanted

THIS plant, peculiar to the Wimmera in its development, is now widely used, not only in the wheat-growing districts of Victoria but also in the dry areas of New South Wales, South Australia, and Western Australia. After many years of use and of numerous trials with other genera, it remains the premier grazing plant where a rapid winter growing annual is required and conditions are unfavorable to the persistence of a perennial species throughout the long dry summer months.

From other States reports have been received, from time to time, of the diverse nature of different lines of Wimmera rye grass exported from Victoria. The Department of Agriculture has examined material from various parts of the State, and though different lines have been discovered, the differences so far have been slight. The amount of material available has been limited and the Department desires to obtain seed samples from as many sources as possible, in order that the species may be thoroughly examined for the presence of different strains, or varieties, which are suspected of existing. Growers are invited to co-operate and forward small samples of their seed—about 3 oz.—to the Director, Department of Agriculture, Melbourne, C.2. These samples will be examined in single plant plots at the Burnley Pasture Plant Research Station and any differences from the standard type will be noted.

It is believed that this work will be valuable, not only in classifying existing types of Wimmera rye grass, but also in supplying each grower with knowledge as to the characters of the particular line which he is marketing at the present time. The requirements of interstate buyers are being studied, and it is expected that information of the nature of suitable strains for export will become available also. It is hoped that growers in the Dunkeld district, the Wimmera, the Mallee and Northern Victoria, where the main seed supplies are grown, will respond to the departmental appeal and forward samples of this year's harvest as soon as possible.

The Tobacco Industry

Its Problems Discussed*

By W. J. B. McDonald, B.Agr.Sc., Inspector of Agriculture.

VERY few industries have experienced a more chequered career than has the tobacco industry, nor have any been more spectacular in their development during favorable periods nor more depressing in their aspect during unfavorable periods.

While general cultural and curing practices have made progress during the last twenty years, the major disabilities under which the industry labours have increased rather than diminished. In recent years these have been intensified by—

1. Its rapid expansion.
2. Its changing personnel.
3. The general adoption of lighter varieties of tobacco, which apparently are more susceptible to disease, but which are demanded by the manufacturing interests.

There are numberless problems associated with the successful cultivation of tobacco leaf, but one beside which all others pale into insignificance is the loss caused annually by the incidence of the disease known popularly as " blue mould," or more correctly as " downy mildew of tobacco," *Peronospora tabacini* Adam (1)

If this disease could be controlled economically, I think that within a period of three years Victoria alone could produce a volume of saleable leaf equal to the amount imported into the Commonwealth annually.

The amount of successful research into tobacco questions peculiarly Australian, is distressingly small—there yet remains a great deal of elementary data to be accurately recorded. I propose in this paper to furnish rather briefly a summary of results that have been obtained from field experimentation and to indicate the main problems as they appear to me after three years observation of the industry in various corners of the State.

* A paper read before Section " K " (Agriculture and Forestry) of the Australian and New Zealand Association for the Advancement of Science, Melbourne, January, 1935.

For a proper appreciation of the Victorian tobacco industry in its present condition it is necessary to consider briefly the history of its development. This has been characterized by a series of booms and depressions, with but few periods of comparative stability. Probably tobacco was introduced to Victoria more than 70 years ago by migrating miners, who brought in seed and cultivated the plant for their own use. This view is supported by the fact that the oldest districts are those which, in their early days, were associated with considerable mining and dredging activities. Whatever its origin, however, the tobacco industry, soon after its inception, was almost monopolized by Chinese growers, who found little difficulty in producing heavy yielding crops along the rich alluvial flats of the Ovens and King River valleys in the north-eastern district of the State.

The leaf, all of which was either sun or air dried, was coarse and heavy in texture and dark in colour; but, despite these characteristics, a fair proportion of it found a ready local market at prices ranging from 2d. to 8d. per lb. Nearly 50 years ago Victoria's annual production of leaf occasionally was as great as it is likely to be in the present season, although the area prepared for tobacco this year is from five to six times as great as was the acreage planted in the year of this State's early peak production (1888–1889). That fact alone is a significant indication of the accumulated difficulties with which the present-day grower has to contend.

During the latter end of the nineteenth century accumulated stocks of locally-grown leaf so depressed the market that tobacco growing, as a commercial proposition, almost ceased during the first decade of the present century. About 1910 some revival of interest occurred and, with the gradual adoption of flue curing as a means of drying the leaf and the increasing demand for a leaf of a lighter and brighter type, the Chinese, who could not forsake successfully old-established practice, were ousted from the industry by ever-increasing numbers of white growers. At the moment there are few, if any, Chinese growers in Victoria. It is necessary to remember, however, that the bulk of the Victorian tobacco crop still is produced in the same district and on soil types similar to those exploited by the Chinese more than 50 years ago.

Prior to 1925 very little tobacco growing was attempted outside the North-eastern District, but in that year the Pomonal district, at the foot of the Grampians Mountains, which was regarded as possessing soil characters adapted to the production of a lighter class of tobacco than that normally produced in the north-east, was tried tentatively as a tobacco-growing area, and the success obtained in the first year was considered sufficient to warrant its further exploitation Pomonal now is a recognized tobacco-growing district, although its rate of increase in production has not been consistent with the optimism of its original sponsors.

In 1927 tobacco was planted on the easily irrigated red sandy loams of the Shepparton East district, and rapidly spread northwards to the low sand hills fringing the Murray River in the vicinity of Cobram, Yarrawonga, and Gunbower. Since that date it has been tried experimentally in nearly every portion of the State, but outside

Planting tobacco with the mechanical transplanter.

the North-Eastern, Pomonal, and Shepparton districts cannot be regarded as a crop definitely established.

In the year 1929 there was evidence of marked expansion in the acreage planted to tobacco and, during the next two years, this tendency was given tremendous impetus by several factors, the most important being the prevailing economic depression. To understand the reason for the recent rapid expansion of the Victorian tobacco industry, it is necessary to give some attention to the influences affecting the Australian industry in immediately preceding years.

A tobacco plantation in East Gippsland.

In evidence before the Tariff Board in 1926 the representative of the British Australasian Tobacco Co. offered, on behalf of the company, to provide £50,000, on a £1 for £1 basis with the Federal or State Government, to assist in developing any district in Australia, which could satisfactorily demonstrate its ability to grow tobacco equal in quality to that grown in America. This offer resulted in the formation of a body known as the Australian Tobacco Investigation, which conducted experimental and demonstrational work in various parts of the Commonwealth, and directed more public attention to the possibilities of tobacco growing.

In August, 1929, the Customs duty on tobacco was increased from 2s. to 2s. 8d. per lb., and in November of the same year to 3s. per lb. In December, 1930, it was increased again to 5s. 2d. per lb., the excise duty being left unaltered at 2s. 4d. This meant that in 1930 Australian-grown tobacco was protected to the extent of 5s. 2d. per lb.

This artificial protection greatly enhanced the prospects of tobacco growing as a livelihood at a period, which coincided with considerable unemployment following the depression, and a reduced purchasing power of the public, due to the same cause. The net result was the invasion of the tobacco-growing industry by an army of new growers, and a demand for cheaper tobacco, which incidentally meant Australian, by a still larger army of impoverished smokers.

Between the seasons 1930–31 and 1931–32 the acreage planted to tobacco increased by 360 per cent., resulting in the record crop of over 6,500,000 lb. of leaf in the latter season. By the end of 1933–34 season the annual production had dwindled to slightly more than 1,000,000 lb. of cured leaf, and the prospects for the present season are no brighter.

The boom in tobacco growing was the direct result of changing economic and politcal influences—peak production was not due to the boom alone, it was the result of the boom allied to a favorable season. The subsequent collapse in production was due, not to any marked diminution of interest in the industry, but to a series of seasons which, paradoxically, gave us conditions, in many respects conforming more closely than usual to the theoretical conception of those favouring the growth of tobacco.

The major problem confronting the industry now rather broadly defines itself as one involving continuity of production in an average season. The tobacco-growing districts are suitably leavened with a sufficiency of efficient and experienced growers, well equipped with all the plant necessary to a well-conducted plantation, and yet, disregarding altogether the economy of precautions adopted, it is not yet possible to ensure that 50 per cent. of the area prepared for planting ever will come to fruition or even be established.

The chief cause of the instability is the prevalence of the disease "downy mildew." Production can never be regulated nor stabilized, nor can investigation of the problems associated with refinements of tobacco culture be completely successful, until methods of combating this disease have been evolved. It is accepted generally that the disease is due to the presence within the tissue of the tobacco plant of a parasitic fungus, the morphology of which has been described by Adam (1). It manifests itself by the production of dense masses of conidia of a bluish-grey colour

The Blue Mould Fungus on the under surface of a tobacco leaf. [*Queensland Agricultural Journal.*

usually on the under surface of the leaf. This bluish appearance has given rise to the popular name "blue mould."

Sporulation usually occurs in somewhat irregular areas, and is preceded by a slight yellowing of the affected area. The disease is capable of attacking the tobacco plant under a huge range of conditions and at any stage of its history, although maturity of the leaf, especially if combined with normal growth, appears to lend some degree of immunity.

Generally the disease is most prevalent during spring and early autumn, diminishing to a minimum during normally dry summer months, but if this latter period be characterized by what are regarded as unseasonal rains it continues in epidemic form. Spring infection is the most dreaded, as this may cause a total loss of the seed beds, resulting in an insufficiency of seedlings to establish the desired plantation. When a grower's seed beds are destroyed in this fashion he endeavours to purchase plants from other growers who have allegedly clean beds; but usually it is found that, where infection occurs early in the season, practically all tobacco nurseries in the State are affected, and hence the area eventually established is seriously curtailed.

Autumn infection is restricted to plants already established in the field, and while not normally causing a total loss in northern areas, is capable of seriously impairing the commercial value of leaf harvested from affected plantations. In Gippsland, however, that later field infection is capable of destroying utterly an almost mature crop.

Where infection of the seedling occurs after transplanting, the disease may take the form commonly known as "spot mould," in which it apparently is confined to the leaf and results in leaf lesions which, if at all numerous, effectively destroy its value, or it may attack the stem and root system, either killing the plant outright or resulting in a stunted or anaemic type of plant, which may or may not develop leaf lesions. It is possible for a systemically infected plant to produce a light crop of good coloured leaf, although such leaf lacks body and elasticity.

As previously indicated, however, it is during the period in which the seedlings remain in the

Two nearly mature leaves from a diseased plant compared with a healthy leaf. [*C.S.I.R. Bull.* 65.

nursery that the greatest loss from "downy mildew" arises. Here again there is little observable consistency in the result of the attack, or in the nature of the conditions, which may be regarded as a pre-requisite to attack. Infection may spread rapidly throughout the seed bed, resulting in 100 per cent. mortality in a few days; it may be restricted for quite an appreciable time to odd plants scattered throughout the bed, or it may be confined to well-defined areas, and may eventually disappear of its own accord. Usually, however, once sporulation occurs anywhere within the bed, the spread of the disease is rapid and devastating.

Even if the attack appears to be but a superficial one, apparently clean plants from such a nursery do not give a satisfactory percentage "strike" when set out in the field, and those that do take make but poor growth and run rapidly to seed. It will be understood readily, that once a general infection of the tobacco nurseries of the State occurs, the prospects of harvesting a satisfactory crop of leaf in that season are destroyed. Such a condition has occurred here during the three past growing seasons.

Owing to the inconsistency of its behaviour it has been particularly difficult to obtain reliable data reflecting conditions favorable to the incidence of "downy mildew." From the observations of numerous growers and a few investigators a little empirical knowledge has been gained concerning conditions favouring the development of the fungus. For instance, in spring or early summer, there is general uneasiness among seedling growers during humid weather, particularly if it has been preceded by damp or cold weather. Almost invariably such weather is followed by an outbreak of disease. Once conidia are produced the subsequent spread of the the disease becomes progressively more rapid as long as humid or damp weather conditions prevail. Hot dry weather depresses the rate at which disease develops and may check its spread altogether.

It is of fundamental importance that all means of infection should be determined. Several possibilities present themselves immediately. Infection possibly may be introduced with the seed, it may arise from the soil, or it may result from the lodgment of spores carried by the wind or some living agency. Let us consider briefly each of these possibilities.

Angell (3) has suggested that the tobacco seed is capable of carrying disease. While it is easy to believe that infection of the seedling would follow naturally under suitable conditions, but little success has been obtained in attempts to raise infected seedlings from seed suspected of being diseased, under conditions which exclude all other possible sources of infection.

Adam (1) states that oospores develop under suitable conditions but has not demonstrated that the oospore is capable of causing a diseased condition of tobacco. There is, however, a possibility of the oospore overwintering successfully in the soil of an area which previously had produced infected plants, and of functioning as a means of infection in the following season. Practically all seed beds, however, are established in soil virgin to tobacco.

In 1930 the Victorian Department of Agriculture established a series of seed beds in virgin soil, which, prior to seeding, was steam sterilized. These beds were sown with seed, which was imported from an area in which "downy mildew" had never been recorded. The seed was, therefore, regarded as being free from any possibility of infection. Portion of the beds was established under glass-house conditions, and portion under natural field conditions. Both series of beds developed the disease. There are numerous instances in which imported seed has been planted in virgin soil, remote from any tobacco plantation, and has produced sturdy seedlings, which later, have contracted disease while still in the seed bed.

While recognizing the possible significance of the seed and soil as sources of infection, I believe they play a relatively small part in the general infection that at present is characteristic of Victorian seed beds. I am forced to the conclusion, then, that spores carried either by air or some living agency are responsible mainly for seed-bed and field infection. In this respect Angell and Hill (5) have shown under controlled conditions that insects are capable of transmitting the disease from one seedling to another, and general observation in the field substantiates this view. Disease infection often is closely associated with insect damage. It is probable, however, that air-borne spores are the most prolific source of infection, especially after the first crop of conidia have been produced.

In old tobacco-growing districts plants which survive the winter and produce sucker growth early in spring are undoubted sources from which the aerial population of disease spores could be recruited. Where, however, seed beds established in areas remote from overwintering plants contract disease, one must conclude that spores are capable of being carried great distances by air, or that there is some prevalent host plant not yet recognized.

Victorian Experiments.

I propose now to indicate the avenues along which recent Victorian efforts to raise disease-free seedlings have been directed, and to state the results that have been obtained.

The first avenue explored was the possibility of *isolating by selection a strain of tobacco resistant or tolerant to the disease.*

In the season 1930 seed heads from plants which had apparently remained clean in badly-diseased fields were selected, and the seed from each head retained as an original stock. Seed from each stock was planted under ordinary seed-bed conditions, and the healthiest seedlings raised from each were planted in the field. At maturity seed from the healthiest adults, which were protected from cross-pollination, again were selected and the process repeated.

Blue Mould damage.

The fourth generation of seedlings was totally destroyed by downy mildew in October, 1934.

The second avenue involved *the investigation of spray treatments.* It was hoped that an adequate application of fungicidal sprays to the leaves of the tobacco seedling would protect it against disease. Bordeaux mixture 4–4–40, colloidal copper, copper emulsion, and lime sulphur sprays were applied to various beds at intervals of two, four, and six days, and to a further series whenever the judgment of the experimenter deemed spraying to be advisable. During last season, when conditions admittedly were particularly favorable to downy mildew development, each series of beds eventually was completely wiped out by disease.

While admitting that colloidal copper, copper emulsion, and lime sulphur sprays have not been as exhaustively tested in Victoria as has Bordeaux mixture, results so far obtained from their application are disappointing. All of the above sprays delay sporulation of the fungus to a certain extent, but they do not prevent fairly heavy infection. Heavy and frequent spray applications definitely retard the rate of growth of the seedling while it remains in the seed bed, and result in excessive burning off of that portion of the seedling exposed above ground level after transplanting. The "strike" from heavily sprayed plants, which do not exhibit obvious disease symptoms, often is very poor. The following figures represent the percentage survival of transplants from beds which had been sprayed with the fungicide indicated:—Copper emulsion, 35 per cent.; Bordeaux 4–4–40, 14 per cent.; colloidal copper, 32 per cent.

Applications of various fungicidal powders, such as lime, sulphur, and copper carbonate, also have failed to exercise any adequate control over disease infection. Queensland investigators claim to have obtained moderately effective seed-bed control of downy mildew by the use of colloidal copper sprays. Under Victorian conditions we have not yet been able to emulate their success. The obvious weakness in spray application arises from the difficulty experienced in obtaining a complete cover of both surfaces of the leaf. During its early growth the tobacco seedling remains flat on the ground, and it is almost impossible to cover this under surface without disturbing the root hold of the young plant. While the possibility of controlling disease by the use of fungicides has not been exhausted completely, results so far obtained are not very encouraging.

The third line of investigation was directed towards *the development of special seed frames allowing control of temperature and water.* It is believed generally that the development of downy mildew on tobacco is associated with temperature variation and the occurrence of free water on the leaf surface. Past experiments have shown that seedlings grown under glass in conditions which provide for subterranean watering of the beds

and allow the maintenance of uniform air temperature conditions, usually fail to survive the hardening off period, succumbing to the disease shortly after exposure to ordinary atmospheric conditions.

Mr. R. G. May, of the Bathurst Experiment Station, observing that the disease usually followed a spell of cold weather, devised a type of seed frame, whereby it was possible to maintain the soil temperature at or above a certain level—45 deg. F. he regarded as the critical minimum. The beds, which were protected from the weather by waterproof calico covers, were watered only with tepid water, which previously had been boiled. Mr. May, by these means, was able to produce clean seedlings for a period of fourteen years.

Similar frames were this year constructed in Victoria and managed, along lines recommended by Mr. May, by the State Department of Agriculture and the Council for Scientific and Industrial Research, but in both cases, and in Mr. May's own frames at Bathurst, downy mildew developed. It is possible, however, that by varying the minimum temperature to which the beds are allowed to fall, more successful results may be obtained. It is possible also that the thermal death point of the fungus is lower than that of the seedling, and should this be the case, it may prove feasible to exploit this difference.

The fourth line of work was directed toward *the location of areas whose natural climatic features may be unfavorable to the development of downy mildew.*

In the earlier days of tobacco growing, seedlings always were raised in areas adjacent to the fields to be planted. As disease attacks became more widespread and frequent, growers with initiative and courage ventured into districts where tobacco previously had not been grown to raise their seedlings. As it generally was believed that cool wet conditions favoured downy mildew, growers naturally went north into warmer and drier districts. Cobram was one of the first areas exploited for this purpose. For two or three seasons the sandy rises of this district produced great numbers of clean seedlings; but disease then made its appearance, and Cobram now is just as liable to disease infection as any other district.

During the last five years seedling growers have gone farther and farther afield until, at the present time, most of the areas within reach of the tobacco-growing districts by road or rail have been covered by seedling growers. Portions of Gippsland, the Northern Mallee, and the Western District remain still unexploited. These districts represent the extremes of climatic conditions available in Victoria.

Downy mildew on upper and lower surfaces of leaves of tobacco seedlings. [*Phytopath.* Vol. XXIV.

In 1934 the Department of Agriculture determined to explore the possibilities of these climatic extremes as possible seedling growing areas. Seed beds consequently were established at Werrimull and Walpeup in the Mallee, the warmest and driest district in the State. This area carried, as part of its natural vegetation, an appreciable amount of *N. glauca*, native tobacco capable of acting as a host for downy mildew. As far as can be ascertained, no cultivated tobacco had been grown previously within 40 miles of Werrimull, nor within 20 miles of Walpeup. Imported

A bed of healthy tobacco seedlings.

seed, i.e., clean seed, was planted in both instances in red mallee sand, which would absorb water almost as fast as it could be applied. A careful examination of existing plants of *N. glauca* in this district failed to reveal any sign of the presence of downy mildew.

Official investigators, who may have been capable of carrying disease spores on their person, refrained from visiting the beds during the early spring months and, as far as is known, no other person liable to be infected with disease spores visited these seed beds, yet in both instances downy mildew developed and became visible during the month of October.

Admittedly the weather in October in 1934 was abnormally wet and humid, but the important point remains that in a district with an average annual rainfall of 11 inches, 1 inch of which falls during October, and with a mean October temperature of 63.7 deg. F., downy mildew is capable, in some years, of completely destroying the seed bed.

This experience causes one to ask whether the success sometimes achieved with the first introduction of tobacco seed to a new district is not due in large measure to its coincidence with seasonal conditions unfavorable to the development of the disease.

I will not discuss seed beds established under intermediate climatic conditions, except to say that all of them became diseased, and pass on to those planted at Beech Forest at an elevation of 2,000 feet, and with an annual rainfall of 70 inches. At this centre clean seed was sown in September, 1934, on virgin soil, and germinated very slowly. Subjected to continued cold and wet weather during October, November, and December, seedlings made very slow growth, and exhibited signs of downy mildew about the 24th December, 1934. The rainfall during the last three months of 1934 totalled 2,097 points, and the mean temperature during these months was 52.3 degrees — maximum weekly average, 58 degrees; minimum weekly average, 47 degrees. As far as can be ascertained no cultivated tobacco was growing within 40 miles of Beech Forest, and no recorded host of downy mildew existed in the district.

From a consideration of the results obtained at these centres, and from others not enumerated, I would suggest that downy mildew is endemic over the whole State; but that the introduction of seedling growing to a new district rapidly augments the sources from which infection can arise, so that inevitably under present conditions seedling growing becomes more precarious the longer any specific area is utilized for that purpose. Were tobacco residues rigorously destroyed this now increasing liability to infection should be minimized, although I am not so optimistic as to believe that it would be eliminated.

In Northern Victoria downy mildew becomes prevalent in the seed bed usually early in October. In Melbourne and parts of Gippsland it usually does not assume serious proportions until November, and in more southern districts, I believe, it would not become prevalent normally until still later in the season. Speaking generally, the farther north one travels the earlier the disease assumes epidemic form. It would seem that in this time-lag between the appearance of disease in north and south Victoria lies our greatest opportunity of obtaining clean seedlings.

The first appearance of disease in northern seed beds coincides usually with preparations for early planting. If by special seed-bed management early seedlings could be produced in what normally are late districts, I feel that northern tobacco fields at least could be planted with clean seedlings. There still would be the risk attaching to field infection, but the risk in the field is not so great as that in the seed bed.

It may be of course, if downy mildew is related to seed-bed conditions more intimately than to general atmospheric conditions, that measures devised to produce early seedlings in a late district

also would produce an early appearance of disease. I incline to the belief that they would not.

If seedling growers retain their present rate of spread to new districts, it is probable that, within five years, there will remain no part of Victoria or New South Wales which has not been exploited in this respect.

The direct economic loss due to downy mildew can be summarized as occurring under the following heads :—

(*a*) Loss due to the necessity for the provision of an abnormally large supply of seedlings.
(*b*) Transport charges occasioned by the remoteness of the nursery.
(*c*) Loss due to death of seedlings.
(*d*) Cost of replanting seedlings which exhibit disease after transplanting.
(*e*) Degradation in quality of mature leaf due to delayed planting.
(*f*) Loss due to leaf damage following field infection.
(*g*) Loss due to curtailment of the acreage planted.

In these last two items alone it is estimated that in the past two seasons downy mildew has cost this State the value of approximately 6,000,000 lb. of cured leaf.

Section of tobacco stem showing Stem Grub (left) and pupa (right), also damage done to interior of main stem (enlarged).

Other Problems.

Other problems associated with tobacco growing have been so overshadowed by the importance of the disease question that, as yet, many of them have hardly been recognized. The loss arising from insect pest damage has become so acute during the last three years, however, that this aspect of the industry must be given immediate recognition. In some seasons damage from this source threatens to become as extensive as that from downy mildew unless early control measures are developed. The greatest damage arises from the attacks of cut-worms, and what are known popularly as leaf-miner and stem grub, the larvae respectively of *Phthorimeae operculella* and *Phthorimeae heliopa*. Cut-worms are prevalent every year, and can be controlled relatively easily by the use of poison dusts or baits. They are well known to the tobacco-grower, who adopts the necessary control measures as a normal part of his ordinary routine.

In the case of leaf-miner and stem grub, no adequate control measures have yet been devised, and there is a lack of information relative to their habits and life-histories under local conditions. The larva of *Ph. operculella*, as its common name leaf-miner implies, bores through the epidermis of the leaf and feeds on the cellullar tissue. It is thus adequately protected from poison or contact sprays. In this case loss is caused through damage to the growing leaf. The larva of *Ph. heliopa* bores into the stem, usually just below the heart of the plant, and eventually pupates there. Attack by this grub invariably is followed by the collapse of the aerial portion of the plant. It also is protected from attack by poison or contact sprays. Infestation in both cases may occur either in the seed bed or in the field, but in the case of stem grub particularly, it is believed that the greatest degree of infestation occurs in the former.

In the nursery established at Walpeup last season approximately 80 per cent. of the seedlings were attacked by stem grub, although tobacco had not previously been grown in that district. The most feasible means of control seems to rest with the use of a repellent spray, which would prevent the moths from laying their eggs. Experiments have been commenced in which tuberol emulsion was utilized as the repellent, but no results could

Manurial Trials at Stockdale—Unmanured plot in the immediate foreground.

be recorded as the beds concerned were destroyed by disease before there was any development of larvae.

The investigation of cultural problems, such as fertilizing, topping, picking, &c., has been delayed, owing to the difficulty experienced in obtaining adequate supplies of seedlings necessary for the establishment of the field plots essential to such work. Various past attempts at field experimentation did not achieve significance, because the accuracy of the result obviously was so affected by disease infection. With the rapid expansion of the industry in 1930, however, it was felt that this class of investigation could be suspended no longer, and a series of field experiments directed toward the solution of this type of problem was commenced by the Department of Agriculture.

Significant results so far have been obtained only at Shepparton in the Goulburn Valley and at Stockdale in North Gippsland. The tobacco at Shepparton was grown on red sandy loams with the aid of furrow irrigation, and that in Gippsland on light-grey sandy loam under natural rainfall conditions. Even in dry seasons soil moisture has not been a problem at Stockdale, although downy mildew has caused a great deal of damage in the field each season in which experimental plots have been established.

Without attempting a detailed analysis of the results which already have been published (7), I will indicate briefly the tentative conclusions drawn, but must emphasize that they have not been confirmed by findings extending over a number of years.

Fertilizer Trials.

Superphosphate is essential to a reasonable crop yield under conditions similar to those at Stockdale, but does not enhance yield under conditions similar to those at Shepparton. It does, however, hasten maturity and improve the quality of the cured leaf.

The most economic application is considered to lie between 3 cwt. and 5 cwt. per acre. Dressings of 7 cwt. per acre depress crop yield without improving the quality of the cured leaf. At Shepparton a dressing of this nature appeared to suspend the growth of the plant just prior to the ripening period. The plant neither increased in bulk at a normal rate nor fulfilled its promise of particularly early maturity.

The application of nitrogenous manure in the form of dried blood, applied at the rate of 150 lb. per acre, had no appreciable effect on yield, quality, or period of maturity.

Potash applied as potassium sulphate at the rate of 150 lb. per acre had no apparent influence on the crop. No fertilizer treatments have exerted an observable influence on disease resistance.

Experiences up to date suggest that superphosphate is an essential fertilizer in all Victorian tobacco fields, but the economic value of nitrogen and potash have yet to be assessed.

Variety Trials.

Owing to the difficulty experienced in obtaining suitable seedlings at the required period, variety trials have not been so comprehensive as was desired. Necessarily, trials of this nature have been restricted to the use of seedlings which were known to conform closely to the variety they were supposed to represent. At Shepparton Gold Leaf and Warne have yielded a more profitable body of leaf than have Hickory Pryor, Conqueror, Dungowan, or White-Stem-Oronoco, with Gold Leaf giving a greater return per acre than Warne. Dungowan, which is as heavy yielding a variety as Gold Leaf, has not produced such a high percentage of good quality leaf.

At Stockdale, Warne and Gold Leaf have given greater yields of good quality leaf than have White-Stem-Oronoco, Cash, or Hester, with Warne giving a greater return per acre than Gold Leaf.

In the seed bed there seems to be very little difference in the susceptibility to downy mildew of any of the common varieties. Evidence gathered outside the experimental areas suggests that in the field Dungowan is more resistant to infection than are other common varieties.

Topping and Suckering Trials.

It is well established that topping and suckering greatly increase crop yield. At Shepparton a series of plots allowed to produce sucker growth unchecked suffered a reduction in yield of 179 lb. per acre of cured leaf, as compared with crops kept properly suckered. The effect of topping and suckering on quality of leaf has not been established for all districts, although there is little doubt that on light soils leaf quality is improved by proper attention to this operation.

Time of Planting Tests.

Experiments designed to discover the most favorable planting date have failed, owing to the impossibility of obtaining comparable seedlings over a protracted period of the planting season. The importance of the planting date cannot be overestimated. It has been suggested, even, that the planting out period should be confined by regulation to certain limits, so marked is the influence of the time of transplanting on the quality of the ultimate crop.

The practical grower will be saved a great deal of labour and expense when the relations between time of planting and yield, quality, variety, and pest activity can be well defined.

Conclusion.

Of necessity this paper, so far, has been rather a pessimistic presentation. I would like to conclude on a more optimistic note. Many worthy people have condemned the Victorian tobacco industry on the basis that soil and climatic features were unsuited to tobacco culture. Probably this condemnation was based on an enthusiastic acceptance of the American conception of ideal soil and climatic conditions, and the belief that such were essential to successful leaf production. My particular quarrel with climatic conditions is confined to its association with downy mildew. Admittedly our climatic conditions are different in many respects from those in the main tobacco-growing districts of America, and our soils do not conform exactly to American standards, but the fact remains that we can grow good tobacco and great quantities of it provided the disease problem can be minimized.

Inevitably a good deal of leaf has been grown on soil types that do not produce the tobacco demanded by the modern smoker, but within all of the recognized tobacco-growing districts there are considerable areas of soil types which have thoroughly demonstrated their ability to produce a worthy grade of leaf.

Much of the poor tobacco produced in recent years has been due to inexperience on the part of new growers, and should not be attributed to any other cause. "Soil and Climatic Conditions" have been flaunted so often as a logical barrier to progress that they have distracted attention from the real problems. With the solution of the latter, tobacco-growers naturally will gravitate to the most suitable localities, and I believe will be able to produce tobacco of the required quality.

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Grape Packing

For Local Trade and Export

By F. de Castella, Viticulturist; and B. P. Krone, Fruit Packing Expert.

EACH season large quantities of table grapes arrive on the Melbourne market in faulty condition. Thousands of cases of what appeared on the vine to be good fruit open up wet and unsaleable, ultimately finding their way to the distillery at a price that does not pay for cases and freight.

Some growers specialize in grape packing; their brands are deservedly well known on the market, and command good prices. These are, unfortunately, in the minority. Failure is due largely to inefficient packing; hence a few words of warning concerning the chief dangers to be guarded against may prove of service. These hints deal with grapes for the local (Melbourne) market, and also with those for export. Each will be treated separately.

Table grapes, in order to carry well, must in the first place be properly grown. Pruning, tillage, irrigation, and disease control must receive proper attention. *Excessive watering certainly reduces the keeping quality of the fruit. To market grapes shortly after rain or after a watering is courting failure.* Odd watery berries, with thin skins, burst when the case is nailed down, with disastrous results to the rest of the case. Some varieties, usually good carriers, in certain seasons are more prone than usual to drop some of their berries if a bunch be shaken.

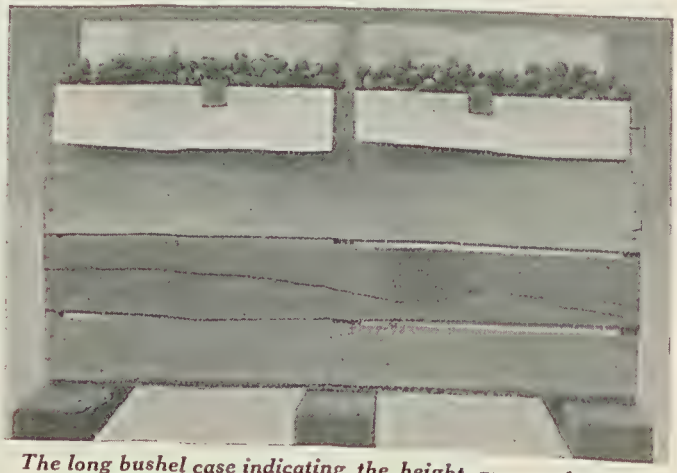
For the Victorian market, Waltham Cross (Rosaki) is by far the most popular grape, although the varieties Gordo Blanco (Muscatel), Black Prince, Red Prince, Red May, Purple Cornichon, and late in the season, Ohanez, are in good demand. For export, the only really satisfactory grape is the Ohanez, although some recent introductions show promise.

Grapes picked or forwarded in very hot weather carry unsatisfactorily. They often reach market during the subsequent cool spell, when grapes are not in demand, and prices slump badly. It would be well to withhold consignments during a pronounced heat wave.

On no account should grapes be picked until they comply with the Departmental Maturity Standard, fixed at s.g. 1.075 or 10 degrees Baumé. Unlike many other fruits, grapes do not ripen after removal from the vine. Regulations concerning grape standards must also be complied with (see page 102).

Careful picking is essential. "Dip tins," into which grapes are often picked, may damage berries through the edges of the holes being burred—lining with paper is therefore advisable. Leaf stalks growing through a bunch often result in injury with careless pickers. The bunches should be held by the stalks, handled as little as possible, and placed in the dip tin in a single layer, with stalks slanting upwards.

Picking can best be done the day before packing and after the great heat of the day. Resting overnight renders the grapes tougher and less brittle, and therefore less liable to injury during packing.



The long bushel case indicating the height grapes should be before dumping and nailing on the lid. If possible defer the latter for some hours, allowing for shrinkage and settling of the grapes.

The packing shed is a frequent source of mould infection. It should be kept as aseptic as possible by careful removal of all traces of damaged berries, &c. Floors, walls, and fittings should be liberally swabbed from time to time with a two per cent. bluestone solution.

Whether grapes are packed in ordinary (long) cases for the local market, or with cork filler, or the paper and wood-wool pack for export, the bunches must be so packed that there will be no movement of the fruit while in the package. The slightest movement or shaking of the bunches is fatal.

In the packing shed it will probably take three trimmers to keep each packer going. All depends on the amount of trimming to be done, and care in this direction often decides the difference in grade designation of the package—whether "Special Quality" or "Second Grade." Bad trimming may materially lessen the growers' returns from otherwise high-quality fruit.

Packing for the Local Market.

The favorite grape pack for the Melbourne market is the long (bushel) case, 26″ x 14¼″ x 6″, internal measurements, clear of central partition. The half-bushel (long) case (26″ x 7⅛″ x 6″) is used also. The grape case (export), 24 5/16″ x 12½″ x 6½″, may also be used ; its capacity is 1,975 cubic inches, or rather more than three-quarter bushel (0.889 Imperial bushel).

Various punnet and carton packs, several of these small units being contained in a crate or case, are coming into use. These are not meeting with the favour they seem to merit. The self-contained unit that would reach the consumer without re-handling should be an ideal pack.

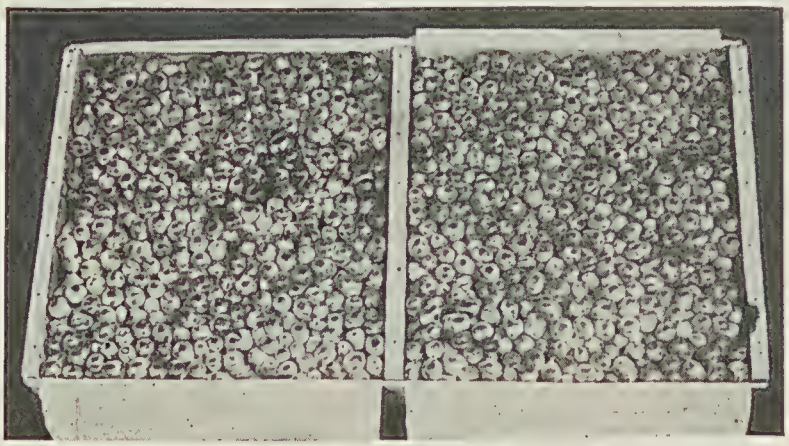
Specifications of timber required for the "long" bushel case, 26″ x 6″ x 14¼″, inside measurements, clear of the division, are as follow :—

Ends and centre piece ..	3 pieces, 14¼″ x 6″ x 11/16″
Sides	6 pieces, 28 1/16″ x 4 11/16″ x ¼″
Lids and bottoms	2 pieces, 28 1/16″ x 6″ x ¼″

The following instructions apply more particularly to the long bushel case. Though this usually is said to hold 40 lb. of grapes, it really holds more. It should contain, as a rule, 50 to 55 lb. ; indeed, with good quality grapes 60lb. can sometimes be packed in. The weight varies with the packer, with the tightness of the pack, and with the Baumé gravity of the grape juice.

Some good packers pick on to hessian, on the shady side of the vine in the afternoon ; the actual packing being done very early the following morning. Others provisionally fill the cases in the evening, piling the grapes higher than the sides of the case. By next morning they will have shrunk very much, so that additional grapes may be needed to fill the case completely.

Careful trimming is essential. All undersized or damaged berries must be removed with a blunt-pointed secateur, the bunch being held by the stalk to avoid damage and conserve bloom. Small sound bunchlets should be kept apart for the final filling before nailing down.



The long bushel case, shown in the previous illustration, with the side removed showing the effect of the system of packing adopted. Grapes only can be seen ; all stalks are hidden.

Line cases with clean white paper. Pack tightly ; the security of the pack lies in its "snugness." Slack packing means damaged and wet grapes. Remember that, though the case is packed with the narrow side open, it is inspected on its wide side. Pack in such a way that when a lath is removed nothing is seen but an even mass of berries, with no stalks showing.

The "Pyramid" pack is recommended, as it ensures even and sufficient pressure. Briefly, this means commencing the pack with rows of bunches along each side, their points in the corners and stalks inwards. The third row is placed slightly above and between the first two, thus ensuring tightness by a kind of wedge action—so on until the case is filled, with occasional gentle dumping or shaking. Such general directions may, of course, need modification to suit the size of the bunches.

Do not nail down until the last possible moment ; full advantage can thus be taken of natural

shrinkage. After the final filling, the grapes should be about 1½ inches above the sides of the case.

Stack cases on the flat; never on the narrow side. Stack in trucks with cases overlapping to permit air circulation.

Packing for Export.

The general remarks on cultural methods and picking apply with even greater force to grapes for export.

For this trade large bunches are desirable. They should not, therefore, be broken up into several smaller bunches. For export, anything smaller than a 50-berry or 8-oz. bunch should not be packed.

The grapes should be graded; remember that they will have to compete with foreign fruit. Grading is easily accomplished. Begin by selecting prime bunches with large-sized berries. Reject excessively tight bunches; they spoil a good pack.

There are two radically different ways of packing grapes for export—

(*a*) The cork-filler pack.

(*b*) The paper and wood-wool pack.

Both permit of grapes being kept in good condition for several months in cool store. The first method has been in use for many years at Almeria (Spain), the latter being of more recent introduction. The paper and wood-wool pack is almost exclusively used for South African grape shipments. Its chief advantages are cheapness and absence of dust when the grapes are opened up.

Quite different packages are used for these two packs.

The Cork-filler Pack.

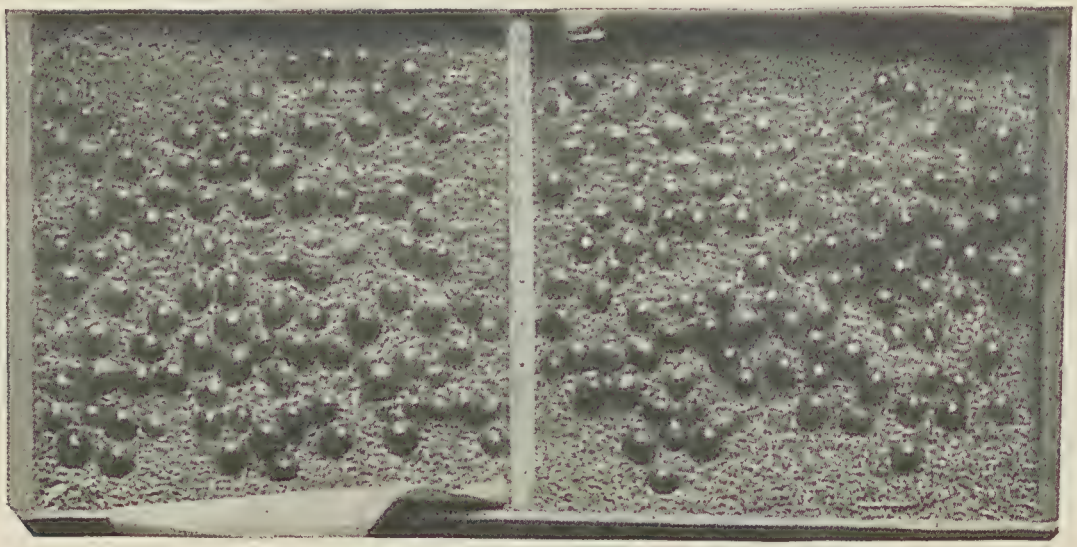
Though sometimes called cork dust, the term is misleading. The filler is really granulated cork, free from dust. The particles must not be too small; rather coarse filler—about dried pea size—preserves the grapes better than that which is finer.

In California a somewhat similar pack is used largely with satisfactory results, coarse sawdust free from dust being employed instead of cork.

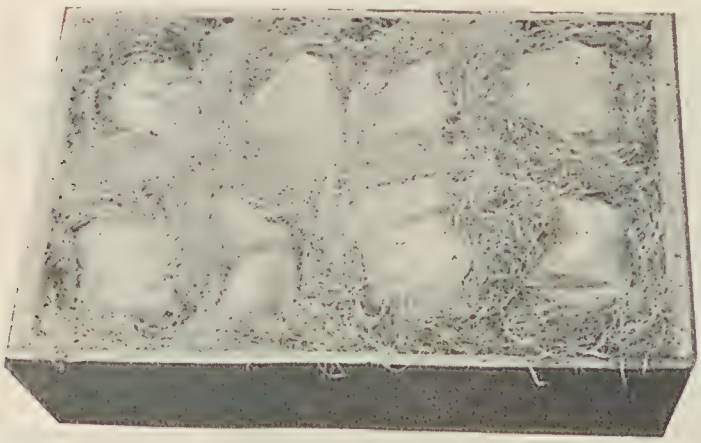
The chief features of the cork pack, as regards safe carriage over long distances, seem to be the rigidity or freedom from springiness of the timber used, and the insulating qualities or capacity for excluding air.

The grape, unlike most fruit, does not require ventilation during transit, hence a close-fitting container (case, barrel, or drum) suits it best. Barrels (as used in Spain) are of prohibitive price here, but the cases used in lieu of them should have boards that fit as tightly as possible and are not flimsy and weak. The dimensions of the approved Ohanez export grape case are $24\frac{5}{16}''$ x $12\frac{1}{2}''$ x $6\frac{1}{2}''$, internal measurements, clear of the centre partition, i.e., nearly nine-tenths of a bushel.

This case holds about 27 lb. grapes and nearly 5 lb. cork. Three bales, each weighing approximately 150 to 160 lb., are sufficient for 100 cases. Obviously, the more grapes, the less filler. The filler must not be skimped or keeping quality will suffer. A little over 28 lb. of grapes should be packed, so that 27 lb. net may be guaranteed at destination. Beginners would do well, for the



Grapes packed with granulated cork-filler.



A ten-pound grape tray with a single layer of bunches wrapped in sulphite paper and packed in wood-wool.

first case or two, to weigh grapes and cork for each compartment. A measure holding 2½ lb. cork will be found convenient.

The cases usually are lined with paper cut to size, but this is not indispensable. Clips should be used to avoid tearing by wind.

1. The case is packed with its broad side open. Spread a fairly thick (1 to 1½ inch) layer of cork on the bottom; spread over it a layer of bunches, fitting them reasonably close together. Handle only by the stalks. Bunches should not fit too closely to sides and ends of case; leave space for cork.

2. Spread a layer of cork over the grapes and shake to settle the grains of cork through the bunches. Repeat the layer of grapes, and finish up with a good layer of cork on top.

3. The cork should be heaped slightly above the sides, so that slight pressure must be applied before the case can be nailed down. It is essential that the fruit be tightly packed with plenty of cork. When the case is opened, only cork should be seen, all grapes being buried in it.

4. Cleats beneath the ends of each case or other forms of insulator should be used to provide free air circulation throughout the stack of cases during storage.

The Paper and Wood-wool Pack.

This style denotes a high-class article, and grapes of first quality only should be used. For this pack the 10-lb. grape tray or box is most suitable. The dimensions are (internal measurement) 18″ x 11½″, with a depth varying from 4″ to 5″, according to the size of the bunches.* Specifications of timber for this tray are as follow:—

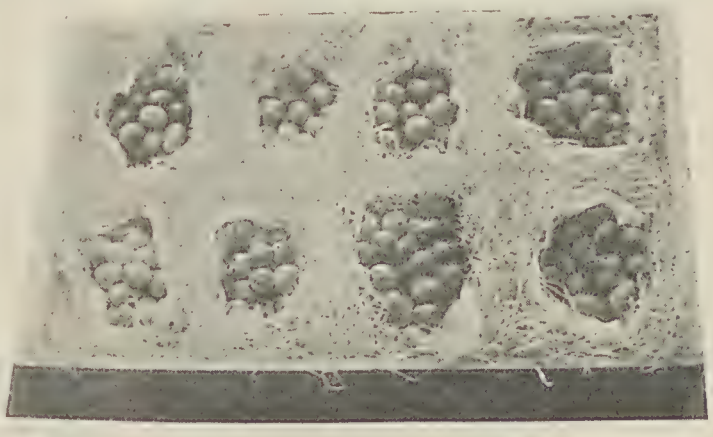
Ends (2 pieces) 11½″ x 4″ or 5″ x ⅝″
Sides (2 pieces) 19¼″ x 4″ or 5″ x ⅜″
Bottoms and lids (4 pieces) 19¼″ x 6⅛″ x ⅜″

The case is made on the flat, to form a tray. This case holds 10 lb. net of grapes or more, according to depth. When packed, this net weight should be somewhat exceeded; the extra weight is desirable to allow for shrinkage during transit.

The grapes are wrapped in "sulphite" tissue wrapping paper in sheets 15″ x 15″, one sheet being used for each bunch. The wrapped bunches are bedded in, and consolidated in the case, with fine wood-wool. Wood-wool usually is sold in bales of approximately one hundredweight (1 cwt.) each, and one bale is sufficient to pack approximately 165 cases of grapes.

The 10-lb. grape tray thus contains rather more than 10 lb. of grapes and one penny halfpenny (1½d.) worth of paper and wood-wool.

Place on the bottom of the tray a generous layer of well-teased wood-wool, drawing it up around the sides and end of the tray, so that the grapes will not touch these. The paper should be folded or semi-twisted beneath each bunch when it is wrapped. Bunches should be placed



The same box as shown above with the paper torn back to reveal the bunches.

* Should the size of the bunches necessitate the use of a tray of greater depth than 4 inches, approval for its use must be obtained from the Department of Commerce. Application for such approval must be made to the Victorian Department of Agriculture.

closely together, with just a thin wall of wood-wool surrounding each, sufficient to prevent movement or shaking in transit. A generous layer of wood-wool over the tops of the bunches completes the packing.

Sulphur Di-oxide Treatment.

This method, for prolonging the storage life of grapes, is now extensively applied in California, where no less than 175,000 tons of fresh grapes were subjected to it last year, before being railed to their destination.

Sulphur dioxide (SO_2), often popularly termed sulphur fumes, is the gas formed when sulphur is burnt in air. This antiseptic, in the proportion of about 50 parts per million, retards development of moulds and decay, thus reducing the rate of deterioration to about half that of untreated grapes, while it does not appreciably affect colour, texture, or flavour.

If the grapes, packed in porous containers, are exposed to air containing two per cent. by volume of SO_2, for 20 to 30 minutes, they will absorb from 50 to 100 parts per million of the gas. Various factors affect the rate of absorption: it is more rapid with grapes that are on the green side; warm and somewhat damaged grapes also absorb it more rapidly. A concentration of two per cent. by volume would mean about $5\frac{1}{2}$ oz. of SO_2 per 100 cubic feet of air, at 60° F., or the gas obtained from the complete combustion of half that weight ($2\frac{3}{4}$ oz.) of sulphur.

Fumigation may take place in a special chamber, but it usually is effected in the railway truck in which the grapes are forwarded. Recent advices state that it is undesirable for the SO_2 content of grapes to exceed 50 parts per million, hence the proportion of this gas in the air should not exceed 1.8 per cent. by volume. Under our warm conditions an even lower concentration would seem desirable. Burning the sulphur inside the truck or chamber has proved unsatisfactory. The usual method is to make a mixture of air and SO_2 of the right concentration outside the treating chamber. This is blown in, so as to displace the original air, which can be accomplished in about 10 minutes with a suitable outfit. The SO_2 may be produced by burning sulphur in a special apparatus, or better, by vaporizing liquid SO_2, as supplied in steel cylinders. In either case fans or blowers regulate and ensure a proper mixture.

Where grapes are packed in close-fitting cases, with cork or sawdust filler, fumigation with SO_2 is not possible. In such instances treatment of the grapes before packing was tried, but with rather unsatisfactory results. An ingenious modification that has recently been devised consists in the mixing of finely-powered bisulphite of potash of soda with the filler, at the rate of about seven grains for each pound of grapes in the case. This has proved quite satisfactory.

For the paper and wood-wool pack it would probably be most satisfactory to fumigate in a special chamber before nailing down the boxes.

The application of this principle on a commercial scale in Australia seems desirable.

Points for Export.

On the arrival of exported Victorian grapes, inspection has shown the chief causes of deterioration to be—

1. Insufficient or delayed cool storage in the early stages.
2. Cracked boxes having been lined with paper to prevent the loss of cork. The presence of cracks permits the carbon dioxide, a natural preservative, to escape.
3. Overtight packing, which damages the fruit at the pedicel and causes a minute oozing of juice at this part. This is responsible later for the well-known "wet" condition in grapes.

The following recommendations, if adhered to, should reduce considerably the present annual loss:—

(i) Second crop grapes must not be packed.
(ii) Harvest at correct stage of maturity—minimum 10 degrees Baumé gravity.
(iii) Handle grapes only by the stalks.
(iv) Prevent "wet" by harvesting dry and trimming carefully.
(v) Pack tightly; security of your pack lies in its snugness.
(vi) The grapes must cool down before packing; precool to 34° to 35° F.
(vii) Use thick boards for cases—minimum thickness $\frac{3}{8}$ inch.
(viii) Close-fitting boards (tongue and groove, cramped together for preference).
(ix) Cases must have cleats, to permit free circulation of air between them.
(x) Immediate cool storage after packing, at 30° to 32° F.

The Department of Agriculture, year after year, has displayed grapes, in very good condition, at the Royal Agricultural Society's Show, at least six months after being severed from the vine. Grapes harvested at Shepparton during a wet autumn have been exhibited seven months later

[*Continued on page* 102.

Orchard and Garden Notes

By Edward E. Pescott, F.L.S.

Oleanders.

The Flower Garden.

THE Oleander is the most continuous and free-flowering of shrubs. It is very hardy, and is a boon in hot or dry districts where the plants flower all through the summer months, requiring a minimum of water. There are single and double varieties, with flowers in shades and colours from white and pale pink to rose-red and deep crimson; there is also a variety with variegated foliage.

Oleanders suffer considerably if given too much water, hence their frequent failure if planted too close to irrigation channels, or where they receive seepage from the channels.

After flowering the old shoots should be cut back for a couple of feet, so as to provide new growth, and to prevent the shrubs becoming too tall and sparse in growth.

Rose mildew will be showing itself if humid weather conditions prevail. The presence of the fungus is indicated by a wilting of the young growths, which show a grey mouldy covering. The bushes should be well dusted with sulphur, preferably when they are moist with the early morning dew. Rose bushes should be given a top-dressing of manure, to force the autumn blooming period.

All seedlings needed to give autumn and winter flowers should be planted out as soon as possible. The best time for the transplanting is during a cool evening; the plants should be watered both before and after the shift.

The Vegetable Garden.

Early crops of cabbage, cauliflower, sprouts, and similar plants may be provided for by planting out the seedlings as quickly as possible. Before planting, the seed-bed should be watered, so that the seedlings may be more easily lifted from the soil; further watering will make them better able to stand the transplanting.

The beds should be very well dug over; some old manure should be worked into them, if the soil is at all poor. But if they have been well manured for the previous crop, such as tomatoes or beans, manuring is unnecessary until the plants are well established. Then some nitrogenous manure, such as sulphate of ammonia, should be given.

The beds must be worked well, so that the tilth will be very fine. This allows for the fine root system to travel and work freely. Then later, when the plants have made sturdy growth, the soil should be freely worked or "hilled" around them, so that a fuller root system may be developed.

After working up the beds thoroughly, and the addition to them of stable manure if available, rows of seeds of carrot, beet, parsnip, and similar root crops may be sown; and lettuce seed as well. French bean seed may also be sown for late crops.

The Orchard.

A Field Day was held last month at Doncaster, so that the results of the Black Spot of Pear experiments, especially the form of attack known as "Summer Spot," might be demonstrated. The result of the experiments shows that pear spot can readily be controlled by three sprays.

The first spray should be given when the brown bud scales are opening, that is, when the young folded leaves are just protruding loosely from the buds. The second spray should be given when the small immature pointed leaves are standing out, well separated from the as yet unexpanded buds.

in good order. It has been proved also, that grapes keep well packed either with cork filler, or with the sulphite wrapping paper and wood-wool, the latter being much cheaper and cleaner.

To leave this spray until the pink colour has developed well in the bud petals will cause much russeting of the fruit. Both the pre-blossom sprays are of Bordeaux mixture at the usual 6–4–40 strength.

These two sprays should be followed by one at half strength, when the very small and young fruits are still in an upright position, approximately about three weeks after setting.

This is the third season (1935) that these experiments have been carried out, and if similar experiments be undertaken in private orchards, good results should be attained against this serious fungus trouble.

Grape Packing

(Continued from page 100.)

From these facts it would appear that, providing certain precautionary measures are adopted it should be possible to export grapes successfully from Victoria to any part of the world.

Grade Standards for Grapes.

(These standards are applicable to local sale only. Export grade standards have not yet been gazetted.)

In addition to compliance with the general requirements of the Fruit Regulations, grapes contained in a package shall be divided into either one or other of four grades, viz. :—" Special," " Standard," " Special Assorted," or " Standard Assorted,"* and shall be graded and packed in accordance with the following provisions :—

(*a*) The package shall be marked with a true designation of the grade, whether " Special," " Standard," " Special Assorted," or " Standard Assorted,"* of the grapes contained in the package ;

(*b*) each external layer of the grapes on the top, bottom, and sides of the grapes shall be a true indication of the average grade of the grapes throughout the package ;

(*c*) grapes described as " Special " shall consist of sound, clean, mature grapes of one variety, of uniformly good colour for the variety, firmly attached to the stalks, not split, crushed, wet, soft, wilted, shrivelled, or scarred ; free from diseased, raisined, dried, or small berries ;

(*d*) grapes described as " Standard " shall consist of sound, clean, mature grapes of one variety, of fairly good colour for the variety, firmly attached to the stalks, not split, crushed, wet, soft, or wilted ; free from diseased, dried, or immature berries ;

(*e*) grapes described as " Special Assorted " shall consist of sound, clean, mature grapes, of not more than three varieties in any package, of uniformly good colour for each variety, firmly attached to the stalks, not split, crushed, wet soft, wilted, shrivelled, or scarred ; free from diseased, raisined, dried, or small berries ; and

(*f*) grapes described as " Standard Assorted " shall consist of sound, clean, mature grapes of not more than three varieties in any package, of fairly good colour for each variety firmly attached to the stalks, not split, wet, soft, or wilted ; free from diseased, dried, or immature berries.

* It is possible that an alteration of these designations may be made shortly to the following corresponding terms :—" Extra Fancy," " Fancy," " Extra Fancy Assorted," and " Fancy Assorted."

Rochester Irrigated Pasture Competition

Report of the Judge, L. C. Bartels, B.Agr.Sc., Senior Agrostologist.

THE irrigated pasture competitions conducted by the Rochester Agricultural Society have had a substantial influence in fostering the spread of sown pastures under irrigation in that district. The splendid exhibits seen, the records of improved production, and observation of the rapidly extending area under pasture afford ample evidence as to the wisdom of the Agricultural Department's strong advocacy of mixed pastures under irrigation.

Species which grow well under irrigation conditions are perennial rye-grass, cocksfoot, Italian rye-grass, prairie grass, perennial red clover, white clover, alsike subterranean and strawberry clovers and splendid mixtures of all of these were seen during the judging of the competition. The character of any pasture depends on the treatment it receives; good irrigated pastures demand regular watering but mere lavishness in this direction is not sufficient. Excessive watering will induce troubles, it will hasten the depletion of fertility and if the land is badly graded swamps will be created.

Fertility must be built up to make the land receptive for the most desirable species, and instead of spoiling land, as is sometimes claimed, irrigated pastures offer a means of reclaiming much ground which has been spoiled by careless watering. Rushes, nut grass, &c., have been definitely crowded out in places where they abounded, merely by the introduction of pasture species and their maintenance by liberal top-dressing combined with heavy regulated grazing. Top-dressing with superphosphate induces the natural spread of prolific strains of white clover.

While it is recognized that the spring rains of this year favored the luxuriant growth of the pastures, there is no doubt that the exhibitors in the competition got the excellent results they did, mainly because of their good methods.

On the whole, the exhibits were more like meadows than pastures and, as a matter of fact, most of them were to be cut for hay. A pasture and a meadow are judged by different standards, and the Society might consider including in its competition sections for both types.

The winning pasture exhibited by Mr. E. Watson, of Nanneella West, consisted of an area of 3 acres sown in 1931 with the mixture recommended by the Department, viz.:

Perennial rye-grass	10 lb. p.a.
Italian rye-grass	3 ,,
Cocksfoot	5 ,,
Perennial red clover	2 ,,
White clover	1 ,,
Alsike clover	1 ,,
Subterranean clover	1 ,,
Strawberry clover	¼ ,,

Mr. Watson included 2 lb. of lucerne seed with the above mixture. The pasture is manured in August of each year with a bag of superphosphate per acre. During the winter, when the ground is moist, the land is harrowed twice with ordinary spike harrows. The pasture is watered in summer after every grazing or mowing. (Usually the herbage is clipped with a meadow-hay mower after grazing).

ROCHESTER IRRIGATED PASTURE COMPETITION 1934.

Name of Competitor.	Layout of Land for Irrigation and Condition of Channels and Drains.	Condition of Pasture.	Mixture.	Uniformity.	Freedom from Weeds.	Total.
Wat on E. (A exhibit)	18	18	20	18	18	92
Clymo, A. L.	18	18	19	18	18	91
Watson, E. (B exhibit)	18	17	17	18	19	89
Glass, A. W.	15	18	18	18	18	87
Schier, H. (A exhibit)	18	18	18	17	16	87
Schier, H. (B exhibit)	18	17	18	16	18	87

Mr. Watson's success is the more meritorious when it is realized that a few years ago, his paddocks bore very scanty feed, nut grass and other weeds being abundant. Some of the area

had been denuded by floods and on much of the land the soil was of heavy texture, but now every year the farm shows improvement, more cows are carried, and abundant reserves of fodder are on hand.

It is claimed by Mr. Watson that the secret of success with pastures is to keep the mower working —the clippings, if worth raking, provide acceptable winter roughage, the pasture is kept fresher and cows eat the young feed more readily. He points out that mowing helps to keep the pasture free from weeds. White clover comes as a result of good farming, but it must be encouraged by manuring and regular watering.

Mr. Clymo, whose exhibit was awarded second prize, showed a pasture with a good mixture of grasses and clovers. He manures this pasture twice a year with 90 lb. of superphosphate per acre each application. It is grazed regularly at intervals of approximately three weeks. Mr. Clymo considers mixed pastures far superior to lucerne for carrying cows. He has not had any trouble from bloat in his herd.

Mr. A. W. Glass showed a splendid mixture of Italian rye-grass and white clover. The persistence of the Italian rye-grass is partly accounted for by the fact that the field has been reserved mainly for hay and last year it was cut three times, but grazed during the winter. The hay produced is considered by Mr. Glass to be better than lucerne hay. Milking cows and lambs have done particularly well on the pasture.

Portion of this land has a high-water table with a tendency to become "salty," and the profuse growth of pasture resembles the growth on similar land at Cohuna. Mr. Glass was one of the earliest settlers to experiment with mixed pastures under irrigation.

Mr. H. Schier has some land which is particularly adapted to lucerne. Although previously he favoured that crop, his experience with a small paddock of mixed pasture, sown in 1929, has encouraged him to extend the area and, aided by a wonderful natural spread of white clover, his farm is rapidly becoming established with pastures. Cocksfoot is considered by Mr. Schier to be a very suitable grass. Superphosphate is applied annually at the rate of two bags per acre.

The pasture plots situated at the district schools have been a contributing factor in the spread of irrigated pastures in the Rochester district. Mr. John Roy, late Supervisor of the Closer Settlement Commission, was mainly responsible for the institution of these, but credit must be given also to the enthusiastic teachers who have guided their pupils in maintaining them.

The plots are simple, and consist of a collection (usually twelve) of the standard grasses and clovers sown in beds (6 feet by 3 feet) with boarded edges. They have allowed the school children to become familiar with the important grasses and clovers and different types of these. The children are encouraged to record their observations on the seeds and early development of the plants—on their habits of growth and botanical features on the seasonal production and longevity of different species. These lessons form the basis for a very sound knowledge of pasture species and that the children have profited is shown by the standard of the entries in a competition for the best essay on the plots.

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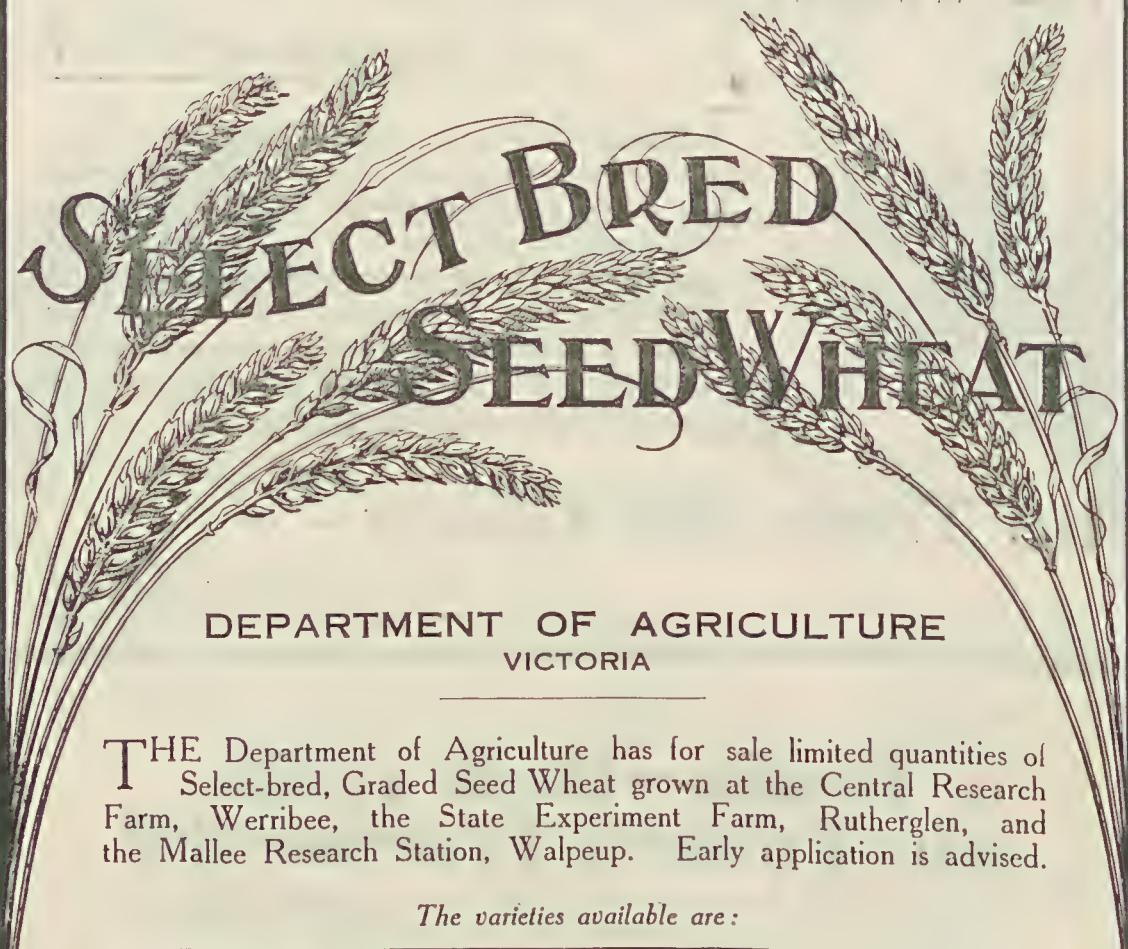

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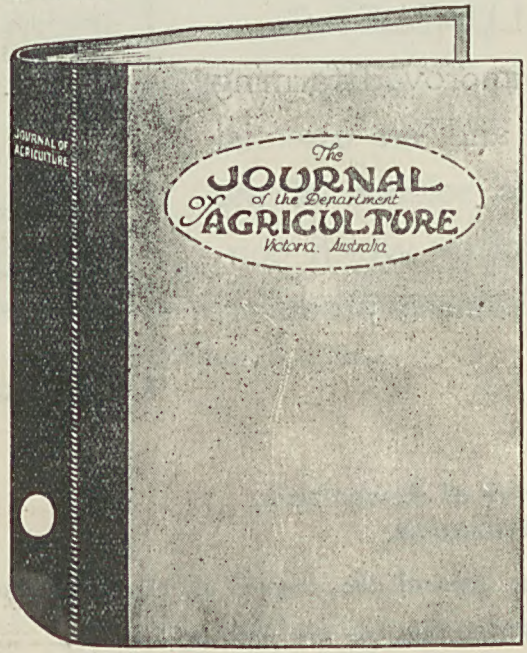

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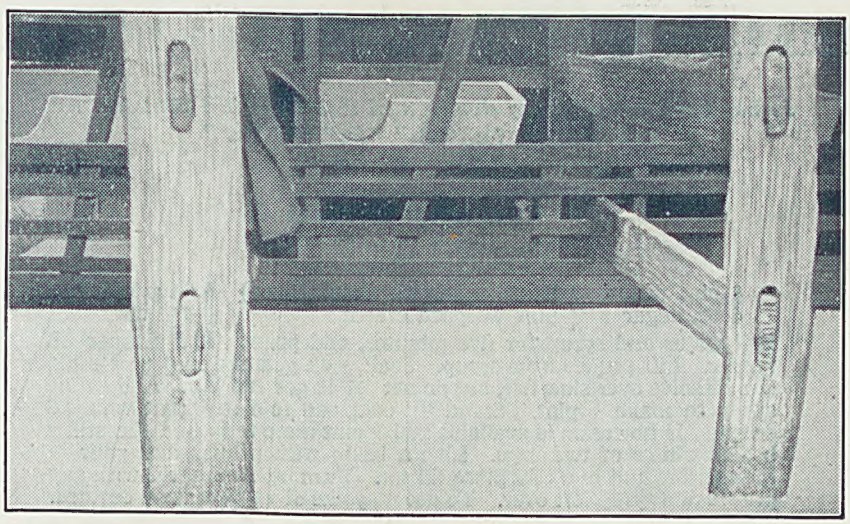

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